समाचार पत्रिका

नेपाल भौगर्भिक समाज

Volume 26 **April 2009 (बैशाख २०६६)**

BULLETIN

OF

NEPAL GEOLOGICAL SOCIETY

NEPAL GEOLOGICAL SOCIETY
(EST. 1980)
PO Box 231, Kathmandu, Nepal
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Giving Impetus to

NEPAL'S Hydropower Development



With the objective of developing Nepal's hydropower resources as a foundation for the nation's development, Butwal Power Company (BPC) since its establishment way back in 1966 has always remain committed to its aim and vision. The company with an affluent experience of over three and half decades and in its pursuit has provided outstanding services to the nation and in the route has given tremendous results to some of the hydropower project works of the country.

BPC owns and operates 12 MW Jhimruk Power Plant and 5.1 MW Andhikhola Power Plant and distributes electricity to over 23,000 consumers and sells energy to Nepal Electricity Authority. BPC also owns 14.9% shares in Himal Power Limited, the company which owns Khimti 60 MW Hydropower Plant, one of the biggest hydropower projects of the country in private sector. BPC is also 51% share holder in Nepal Hydro & Electric Pvt. Ltd., which deals with electro-mechanical works of power projects.

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Editorial

The Editorial Board of Nepal Geological Society is delighted to bring out this *Volume 26 of Bulletin* as its regular publication. This *Volume,* as in other regular volumes, also contains the news about the activities of the Society during the preceding year, number of scientific articles on topics of interest, abstracts or information on papers presented during the ISDR Day-2008 or Scientific Talk Programmes and other information which we thought may be of interest to the geoscientific community and to all others interested in geo-science.

We would like to extend our sincere appreciation and express thanks to all the authors for contributing their papers to this issue of the Bulletin. Special thanks are also extended to Dr Kamala Kant Acharya and Niraj Kumar Regmi for their tireless efforts to bring out this Bulletin. Similarly, we extend our sincere thanks to all the members of the Society who helped us in bringing out this volume. On behalf of the Society, the Editorial Board would also like to acknowledge the consulting firms, agencies, and organisations for their technical and financial support to the Society.

We also hope that this volume will also fulfil the intended purpose behind the motto of publishing the Bulletin of the Nepal Geological Society. We appreciate the valuable comments and suggestions from the members of the Society and other readers for enhancing the Bulletin and hope to receive continued support and co-operation in its publication in the future.

Thank you. **– Editors**

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LIST OF PUBLISHED JOURNAL OF NEPAL GEOLOGICAL SOCIETY

1. Journal of Nepal Geological Society (Proceedings of International Workshop on Seismology, Seismotectonics, and Seismic Hazard in Nepal Himalaya, 28–29 November 2006 and Fifth Nepal Geological Congress on Geology, Environment, and Natural Hazards Mitigation: Key to National Development, 26–27 November 2007), Vol. 38 (Special Issue), December 2008
2. Journal of Nepal Geological Society, Vol. 37, June 2008
3. Journal of Nepal Geological Society (Abstracts of Fifth Nepal Geological Congress on Geology, Environment, and Natural Hazards Mitigation: Key to National Development, 26–27 November 2007), Vol. 36 (Special Issue), November 2007
4. Journal of Nepal Geological Society, Vol. 35, June 2007
5. Journal of Nepal Geological Society (Proceedings of Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28–30 September 2005), Vol. 34 (Special Issue), December 2006
6. Journal of Nepal Geological Society, Vol. 33, June 2006
7. Journal of Nepal Geological Society (Abstracts of Fifth Asian Regional Conference on Engineering Geology for Major Infrastructure Development and Natural Hazards Mitigation, 28–30 September 2005), Vol. 32 (Special Issue), September 2005
8. Journal of Nepal Geological Society, Vol. 31, June 2005
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11. Journal of Nepal Geological Society, Vol. 28, June 2003
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13. Journal of Nepal Geological Society, Vol. 26, June 2002
14. Journal of Nepal Geological Society (Proceedings of Workshop on the Himalayan Uplift and Palaeoclimatic Changes in Central Nepal, 10 November 2000), Vol. 25 (Special Issue), December 2001
15. Journal of Nepal Geological Society (Abstract Volume of Third Nepal Geological Congress, 26–28 September 2001), Vol. 24 (Special Issue), September 2001,
16. Journal of Nepal Geological Society, Vol. 23, June 2001
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21. Journal of Nepal Geological Society (Proceedings of Second Nepal Geological Congress, 1995), Vol. 18 (Special Issue), 1998
22. Journal of Nepal Geological Society, Vol. 17, 1997
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24. Journal of Nepal Geological Society, Vol. 15, 1997
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26. Journal of Nepal Geological Society, Vol. 13, 1996
27. 25. Journal of Nepal Geological Society (Abstract Volume of First Nepal Geological Congress, 1995), Vol. 12 (Special Issue), 1995

28. 26. Journal of Nepal Geological Society (Proceedings of 9th Himalaya–Karakoram–Tibet Workshop, 1994), Vol. 11 (Special Issue), 1995
29. 27. Journal of Nepal Geological Society, Vol. 10, 1995
30. 28. Journal of Nepal Geological Society (Abstracts of 9th Himalaya– Karakoram–Tibet Workshop, 1994), Vol. 10 (Special Issue), 1994 29
31. Journal of Nepal Geological Society, Vol. 9, 1993
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NGS News

The 29th Annual General Body Meeting held in the auditorium hall of the Department of Mines and Geology, Lainchaur, Kathmandu on 18 August 2008 (2 Bhadra 2065 B.S.). President of the 13th Executive Committee Dr. Megh Raj Dhital chaired the meeting. The meeting began with the welcome speech by the president. General Secretary Dr. Dandapani Adhikary presented the Annual Report to the General Body highlighting the various activities and events during the period of 2007/2008 and also presented the plan and programmes for the next year. Then, Treasurer Mr. Dharma Raj Khadka presented the Financial Report including the Auditor's Report for the Fiscal Year 2064/65 B.S. The Report was endorsed by the General Body Meeting.

In order to observe the **International Strategy for Disaster reduction (ISDR) Day-2008**, the Nepal Geological Society, DP-Net, Ministry of Home Affairs, Society of Irrigation Engineers Nepal (SIREN), Society of Hydrology and Meteorology, Department of Hydrology and Meteorology, Tribhuvan University, and Department of Mines and Geology jointly organised a one-day Workshop on Koshi Disaster of 2008 on 22 October 2008 (6 Kartik 2065, Wednesday) in the Russian Cultural Centre, Kamal Pokhari, Kathmandu. The Chief Guest, Honourable Deputy Prime Minister and Minister for Home Affairs, Mr. Bamdev Gautam inaugurate the function and delivered a speech highlighting upon the role of scientists, engineers, and technicians to cope with the natural calamities like the Koshi flood of 2008. He also wished the organisers and about 150 participants to come up with fruitful outcomes of the workshop. In total, including scientific and general, eight papers were presented during the workshop. The Closing Session of the workshop was chaired by Dr. Megh Raj Dhital, President of Nepal Geological Society.

The 30th Special General Body Meeting (SGM) of Nepal Geological Society was held in the auditorium hall of the Department of Mines and Geology, Lainchaur, Kathmandu on 28 December 2008 (14 Paush 2065 B.S.). The main agendas of the Special General Body Meeting were 1) tenure of the Executive Eommittee and 2) land purchasing for the office space of the Nepal Geological Society. For these special reasons, the existing statutes had to be amended. At the beginning of the General Body Meeting, condolences were offorred to the NGS Honorary Fellow, Late Dr. Johann Stöcklin, 1921–2008, of Switzerland. The oucome of the SGM was to amend the existing statutes of the Nepal Geological Society.

As in the past, the Nepal Geological Society celebrated the **11th Earthquake Safety Day-2065** by participating in a three-day long Earthquake Safety Exhibition-2065 held at Bhugol Park, New Road, Kathmandu. The Earthquake Safety Day was organised jointly with the Kathmandu Metropolis. On this occasion, a number of awareness-raising posters and pamphlets and NGS Journals and Bulletins were displayed. Several thousand visitors attended the stall. During the programme, the Nepal Geological Society was appreciated for increasing public awareness through a successful participation in the exhibition.

The Nepal Geological Society nominated the Convenor Mr. K. P. Kaphle and Co-convenors Mr. Shyam Bahadur K. C. and Dr. S. M. Rai for the **Sixth Nepal Geological Congress** which is going to be held in Kathmandu in 2010.

Journal of Nepal Geological Society, Volumes 37 and 38 have been published. Volume 38 of the NGS Journal incudes 1) the Proceedings of International Workshop on Seismology, Seismotectonics, and Seismic Hazard in Nepal Himalaya held on 28–29 November 2006 by the Department of Mines and Geology (DMG), Nepal, in co-operation with Department Analyse Surveillance Environment (DASE), France; and 2) the Proceedings of the Fifth Nepal Geological Congress organised on 26–27 November 2007 in Kathmandu. Similarly this Bulletin of NGS, Volume 26, and the Statutes of the Nepal Geological Society, 2nd Amendment, have also been brought out.

The Nepal Geological Society, Scientific Sub-committee and the Department of Geology, Tri-Chandra College, jointly organised scientific talk programs on the following themes:

1) **Observations of multi-particle interactions in moderate to dense granular shear flows (***by Dr Subodh Dhakal)*
2) **Glaciers, climate, and topography in the Annapurna Range, Nepalese Himalaya** *(by Dr Beth Pratt-Sitaula)*
3) **Qualitative kinematic investigations related to the extrusion of the Higher Himalayan Crystallines and**

equivalent tectonometamorphic wedges in the central Nepal Himalaya *(by Dr Kamala Kant Acharya)*

4) **Geochemical studies of sediments and water, and implications for mobilisation of arsenic into groundwater in Nepal and Japan** *(by Dr Jaya Kumar Gurung)*
5) **Current status of discontinious mountain permafrost in the Nepal Himalaya** *(by Dr Dhananjay Regmi)*
6) **Neotectonics of the India-Asia collision zone: insights from tectonic stress modelling** *(by Dr Deepak Chamlagain)*

The Nepal Geological Society awarded Cairn Energy PLC, Edinburgh, the U. K.; Dhanvi Cement Pvt Ltd, Nepal; Nepal Environmental and Scientific Services (NESS) (P) Ltd; SILT Consultants (P) Ltd; Dywidag-Dragados-CWE JV; and Butwal Power Company Ltd with certificates of appreciation during the 28th General Body Meeting for their financial support to organise the Fith Nepal Geological Congress. Similarly, the NGS awarded with the certificates of appreciation to the following fellow members or associate members for their co-opertion to organise successfully the Fifth Nepal Geological Congress: Mr Shyam Bahadur K. C., Mr Ananta Man Singh Pradhan, Mr Bharat Pant, Mr Anil Khatri, and Miss Sharada Gautam.

Dr Jovan Sebastian Stöcklin, Honorary Fellow of Nepal Geological Society, passed away on 15 April 2008. It was a serious loss to our country and to the geoscientific community as a whole. The Nepal Geological Society offers its hearty condolences to the families, friends, and well-wishers of Late Dr Stöcklin.

29th ANNUAL GENERAL BODY MEETING OF THE NEPAL GEOLOGICAL SOCIETY

18 August 2008 (2 Bhadra 2065 B.S.)

नेपाल भौगर्भिक समाजको उनन्तीसौँ साधारण सभा

Welcome speech by Dr Megh Raj Dhital, President, Nepal Geological Society on the occasion of 29th Annual General Body Meeting

Respected Honorary Fellows of NGS
Respected Past Presidents
Distinguished Fellow Members
Ladies and Gentlemen

On behalf of the l3th Executive Committee of Nepal Geological Society and in the capacity of its President, I am honoured to welcome you all to this 29th Annual General Body Meeting of our Nepal Geological Society. It was really an exciting year for us to work with you all. On this occasion, I would like to mention some of our activities during the past one year. They are:

- **Upgrading the NGS office** at the premises of the Department of Mines and Geology with computers, telephone, and email facilities
- **Observing the ISDR Day:** The Nepal Geological Society, the Disaster Preparedness Network (DPNet) Nepal, and Youth Network for Social and Environmental Development jointly observed the **International Strategy for Disaster Risk Reduction (ISDR) – Day 2007**
- Organisation of **Fifth Nepal Geological Congress** on the theme "Geology, Environment, and Natural Hazards Mitigation: Key to National Development" on 26–27 November 2007 in Kathmandu.
- The Society honoured **Dr. Jovan Sebastian Stöcklin**, Senior geologist of Switzerland, and **Professor Dr. M. Qasim Jan**, Vice Chancellor, Quaid-e-Azam University, Islamabad, Pakistan, with Honorary Fellowships.
- Formation of a new **Editorial Board** with Dr. Rajendra Bahadur Shrestha as the Chief Editor
- Formation of different **Sub-Committees**
- Increasing the transaction of the NGS Journal
- Organisation of a number of **Scientific Talk Programmes**
- Observing the **10th Earthquake Safety Day-2064** by participating in a three-day long Earthquake Safety Exhibition-2064 held at Lalitpur Municipality premises

Apart from these activities, we are also trying to purchase land for construction the NGS Building. The Sub-Commitee on Land Acquisition is working hard to find a good site. In the past one year, the NGS members attended several meetings, seminars, and workshops at National and International levels. We are also working out to amend the present NGS Statutes to make them up-to-date.

Further details of the NGS activities will be elaborated by General Secretary Dr Danda Pani Adhikaril and Treasurer Mr Dharma Raj Khandka.

Distinguished Fellow Members,

To mention forthcoming events, we are going to observe the **International Strategy for Disaster reduction (ISDR) Day-2008.** I request all of you to actively participate in that workshop. You are also requested to participate in the Scientific Talk Programme organised by the NGS. Similarly, kindly give your valuable suggestions on amending the NGS Statutes. Your input in this regard will be very helpful to the Rules and Regulations Sub-commitee.

The 13th Executive Committee is grateful to all of you for your kind support and encouragement. We also extend our sicnere thanks to the Department of Mines and Geology; Tribhuvan University; University Grants Commission; Nepal Electricity Authority; Department of Irrigation; Cairn Energy PLC, Edinburgh, U. K.; Dhanvi Cement Pvt Ltd; SILT Consultants (P) Ltd; NESS (P) Ltd; DDC-JV; Butwal Power Company Ltd; ITECO Nepal (P) Ltd; Himal Hydro and General Consturction Company Ltd.; Hotel Shanker; and all other national and international organisations, associations, institutions, consulting firms, individuals, and well-wishers for extending their kind co-opertion and support to the NGS.

Thank you.

Wishing you a very happy and prosperous New Year 2066 B.S.



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Annual Report by Dr Danda Pani Adhikari, General Secretary, NGS delivered to the 29th Annual General Body Meeting

2 Bhadra 2065 (18 August 2008)
Conference Hall, Department of Mines and Geology, Lainchaur, Kathmandu

Respected Chairman
Honorary Fellows of the NGS
Respected Past Presidents
Distinguished NGS Members and
Ladies and Gentlemen

Namaste and good afternoon!

It is indeed a great pleasure for the 13th Executive Committee of the Nepal Geological Society (NGS) and myself to welcome you all in the 29th Annual General Body Meeting (AGM) of the NGS. It is nearly one year since we took the responsibility of the office of the NGS. In the mean time, the country has witnessed a historic political change as the Kingdom of Nepal has changed into a republic. In its course, the country faced political unrest and the largest number of ***Bandhs*** in the history of Nepal. The inconveniences arising from those activities certainly weakened and delayed our activities. However, we have put our efforts to the extent possible to enhance the activities of the Society and to fulfill its objectives.

On this occasion, I would like to mention the achievements we have made in the first year and the proposed activities to be undertaken in the next year. Our achievements are:

1 Observing the ISDR Day: The Nepal Geological Society, the Disaster Preparedness Network (DPNet) Nepal, and Youth Network for Social and Environmental Development (YONSED) jointly observed the **International Strategy for Disaster Risk Reduction (ISDR) – Day 2007** by organising a two-day programme in Kathmandu, Nepal. The World Disaster Reduction Campaign for 2006-2007 was **"Disaster Risk Reduction Begins at School"** – *"Prakop Jokhim Niunikaran Aviyan Viddhalaya Bata Nai Suru Garaun"*.

The programme in the first day (9 October 2007) was *"Kathmandu Valley Interschool Art Competition"* on ***"Prakop: Hami Ra Hamro Sansar",*** and was held in Basantapur Durbar Square, Kathmandu, and that in the second day (10 October, 2007) was a workshop on "*Prakop Jokhim Niunikaran Aviyan Viddhalaya Bata Nai Suru Garaun"*, which was held at the Nepal Red Cross Society Hall, Kalimati, Kathmandu. The entire programme was supported by the UNDP Nepal, European Union, ActionAid, Oxfam, GEF, and GEF Small Grants Programme.

More than 50 students from 35 schools from Kathmandu, Bhaktapur and Lalitpur, maximum of two, one boy and one girl from a participating school, actively took part in the Art Competition. The message to be conveyed in the art was **Natural and human-induced disasters around us and role of the students and society to mitigate them.** An evaluation committee selected five best arts out of the 50 arts and awarded with Rs. 5000 for the first, Rs. 4000 for the second, Rs. 3000 for the third, Rs. 2000 for the fourth, and Rs. 1000 for the fifth arts.

In the technical session of the workshop, a total of nine papers were presented. Over 70 participants, including representation from academia, scientists, researchers, government ministries, decision makers, policy developers, NGO, INGO, and private organizations involved in the disaster related fields came together and actively took part in the workshop. A fruitful discussion was held following each discussion.

2 Set office, bought computer and arranged telephone and internet and e-mail facilities in the office.

3 **Fifth Nepal Geological Congress:** The Society, in collaboration with the Department of Mines and Geology, Department of Irrigation, Nepal Electricity Authority, and Tribhuvan University, organised the Fifth Nepal Geological Congress "*Geology, Environment, and Natural Hazards Mitigation: Key to National Development"* on 26–27 November 2007 in Kathmandu. There were more than 170 delegates from 6 countries (France, Switzerland, USA, Bangladesh, India and Nepal), and they presented 29 papers, including 4 key note addresses.

In the Inaugural session of the Congress, the Society honoured **Dr Jovan Sebastian Stöcklin**, Senior geologist of Switzerland, and **Professor Dr M. Qasim Jan**, Vice Chancellor, Quaid-e-Azam University, Islamabad, Pakistan with Honorary fellowship.

4 Formation of a new Editorial Board: Chief Editor, Dr Rajendra Bahadur Shrestha, DDG, DMG; Editors, Prof. Dr Georges Mascle, France; Dr Dinesh Pathak, Nepal; Dr Ananta Gajurel, Nepal; Dr Naresh Kazi Tamrakar, Nepal; and Mr Ghan Bahadur Shrestha, Nepal

5 Formation of different sub-committees (the broachers, and mention the name of the committees and the head, but not the whole team). The activities of the committees are underway and the committees are working well.

6 Scientific Talk Programme: In order to encourage the NGS members in research activities and bring together and help keep them in touch, we have arranged scientific talk programmes. So far, the following five talks were held on different dates.

Mr. Subas Chandra Sunuwar, S / N POWER, Lalitpur, Nepal: "***Geological problems in the Hydropower development of Nepal".***

Professor Harutaka Sakai, Graduate School of Science, Kyoto University, Kyoto, Japan: "***Uplift of Himalaya and history of Indian monsoon".***

Dr. Jaya Kumar Gurung, Department of Geology, Tri-Chandra Campus: ***"Geochemical studies of sediments and water, and implications for mobilisation of arsenic into groundwater in Nepal and Japan".***

Dr. Deepak Chamlagain, Department of Geology, Tri-Chandra Campus: "***Neotectonics of the India-Asia collision zone: insights from tectonic stress modelling"***.

Dr. Kamala Kant Acharya, Central Department of Geology, Tribhuvan University, Kirtipur: "***Qualitative kinematic investigations related to the extrusion of the Higher Himalayan Crystallines and equivalent tectonometamorphic wedges in the central Nepal Himalaya"***.

Participation of the NGS members in some talk programmes was low, probably due to tight schedules, ***Bandhs***, and other inconveniences. We are sure that it was not due to the lack of interest.

7 The Earthquake Day celebration: NGS joined the Earthquake Day celebration programme jointly organised by the MOHA, NSET- Nepal, Kathmandu Metrolpolis, and Lalitpur Municipality on Magh 2-4, 2064. We had a stall for the exhibition of our publications. The programme was held in the office premises of the Lalitpur Municipality.

8 **Land Purchasing for NGS:** It has been a decade since we started talking about purchasing land for NGS. The amount we put aside to buy land ten years ago is as it is, whereas the price in most of the places in Kathmandu, in this period, has got more than ten times higher! It is already too late to buy land, and if we are buying we should not make further delay. Realising the fact, a Land Purchasing Sub-Committee was formed and it has been working hard in visiting places (from Tokha to Dhapakhel) and persons to find a suitable piece in a convenient location. But it is getting difficult to find such a piece of land with the amount we have. Finally we are close to a decision. We have been studying a number of other possibilities to find land for building construction, including finding *Parti* land. We have already investigated into this matter and submitted an application to the Ministry of Environment, Science, and Technology. We request our members to let us know if they have information on such possibilities.

9 **Publications:** The NGS Bulletin Volume 25, NGS Member Directory 2008, Brochure 2008, and the back-logging issue of the NGS Journal Vol 34 are the recent publications. As paper price has recently increased by 25%, we have revised the price of our publications. Regular issues will cost from earlier price of Rs 100 to a revised price of Rs150 whereas special issues will cost from the earlier price of 150 to Rs 200, and the Member Directory will cost Rs 50. The NGS Bulletin is free of cost. The price for organisations and non-members will be Rs. 500 for journals and Rs. 100 for bulletins.

Recently, the total members of the NGS have reached 598 (as of July 2008). Out of which there are 431 members from Nepal and 167 from 17 foreign countries. I request the distinguished members to go through the broacher for further details. We have revised the membership fee structure and which is the following.

Entrance fee – Rs 100
Annual fee for full membership – Rs 300
Annual associate membership fee – Rs. 150
Life membership fee – Rs. 2500

Our Executive Member Mr Suman Manandhar resigned on 2064.5.31 and his resignation has been already approved. Similarly, the Executive Committee received a resignation letter from Joint Secretary Mr Pawan Budhathoki on 2065.5.2 and it was approved on the same day.

We still have some problems in communication to some of the members through e-mail, as despite our request many members have not provided updated e-mail address, there may have some errors in the updated Directory, and these are our shortcomings.

The Society congratulates Dr Jaya Kumar Gurung, Dr Deepak Chamlagain, Dr Subesh Ghimire, and Dr Kamala Kant Acharya for receiving their Ph D degree. And, similarly we congratulate Dr Dibya Ratna Kansakar for being promoted to the position of Chief Hydrologist, Gazetted Class –I, Joint Secretary.

I would like to request all the NGS members to co-operate with the Executive committee to enhance the NGS activities.

Future Activities

We will try to make the publications up-to-date and more regular.

The Scientific Talk Programmes will be continued, and the Society will try to make it more frequent, if possible. I would like to request you all to have active participation in the future. Please let the Committee know if you are interested to make presentations.

As in the previous years, the ISDR-Day will be observed, on the given date. I think the UN has yet to decide the theme. Following the release of the theme, the Society will decide if the NGS will organise alone or jointly with other organisations.

New issues of journals are coming in, and we would like to request all the members to purchase all the new issues regularly.

E-mailing system will be strengthened. Please make sure that you have provided your correct e-mail address.

Renewal of the Society and PAN will be carried out.

Membership renewal of general members will be performed.

The Nepal Geological Society is grateful to the Department of Mines and Geology for office space. We also thank the past editorial board: Chief Editor Dr M. R. Dhital, and Editors: Professor Dr Masaru Yoshida, Japan; Dr David N. Petley, UK; Dr Dinesh Pathak, Nepal; Dr Ananta Prasad Gajurel, Nepal; and Mr Ghan Bahadur Shrestha, Nepal.

We sincerely appreciate the efforts of the Land Purchasing Sub-Committee, specially Mr Ashok Kumar Duvadi and Saradesh Raj Sharma who have been working hard to find a good piece of land.

There are also a number of persons who provided special support in organising the Fifth Nepal Geological Congress. In this connection, we thank Mr Shyam Bahadur K. C., Mr Ananta Man Singh Pradhan, Mr Bharat Pant, Mr Anil Khatri, Miss Sharada Gautam, Mr Kangada Prasain, and Mr Ujwal Raghubanshi.

We are extremely thankful to Dr. Rajendra Bahadur Shrestha for accepting our request to lead the editorial board. And similarly, we thank the other member of the board.

Our special thanks are also extend to the following organisations for providing financial support: University Grants Commission, Sano Thimi, Bhaktapur; Cairn Energy PLC, Edinburgh, the U. K.; Dhanvi Cement Pvt Ltd, Nepal; Nepal Environmental and Scientific Services (NESS) (P) Ltd; SILT Consultants (P) Ltd; Dywidag-Dragados-CWE JV, Middle Marsyangdi Hydroelectric Project, Udipur, Lamjung; Butwal Power Company Ltd; and Himal Hydro and General Construction Company Ltd.

Jay Geoscience! Jay NGS and NGS Members!

Thank you.

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- Chemical analysis of solid wastes, soils, and dust particulates
- Monitoring ambient air quality in working environment
- Survey of noise and vibration pollution

Chemical analysis/consulting for any kind of raw materials, suppliers, makers, consumers and public works like:

- Food additives
- Chemical and chemical products
- Quality control tests for industrial products
- Analysis of rocks, soil, and sediments
- Study of special raw materials and their applications

Technical Services on:

- Environmental policies
- Air quality management
- Water/waste water management
- Industrial pollution management policies
- Design of pollution treatment systems
- AlE audit/monitoring
- Watershed management
- Consulting on socio-economic and engineering fields

Research and Development

Annual Financial Report by Mr. Dharma Raj Khadka, Treasurer, NGS presented during the 29th Annual General Body Meeting

नेपाल भौगर्भिक समाजका कोषाध्यक्ष श्री धर्मराज खडकाद्वारा प्रस्तुत आर्थिक प्रतिवेदन

यस सभाका सभापतिज्यू
सम्मानित सदस्यज्यूहरू
यस समाजका पूर्व अध्यक्षज्यूहरू
वर्तमान कार्यकारिणी समितिका साथीहरू
एवं सम्पूर्ण सदस्यज्यूहरू ।

आदरणीय सदस्य साथिहरू,

महासचिवज्यूले उल्लेख गर्नु भएका कार्यहरू संचालन गर्न यस आर्थिक वर्षमा खर्च हुन गएको छ। जसमा मुख्य खर्च Nov 26-27 मा आयोजित Fifth Nepal Geological Congress सम्पन्न गर्न भएको हो। भएको खर्चलाई मोटामोटी रुपमा यसरी विभाजन गरिएको छ ।

यस १३ औ कार्यकारिणी समितिले आ. व. २०६४।०६५ को एक वर्षको कार्यकालमा गरेका आर्थिक गतिविधिहरूलाई अधिकार प्राप्त लेखा परीक्षकबाट परीक्षण समेत गराई यस समाजको २९ औ साधारण सभा समक्ष विगत वर्षमा जस्तै गरी पेश गर्न गइरहेकोछु ।

यसका मुख्य शीर्षकहरूमा भएको Income and expenditure तथा Receipt and Payment सम्बन्धी संक्षिप्त झलक तपाईहरू समक्ष पेश गरी नै सकेको छु। अब म यस समबन्धी मोटामोटी विवरण उल्लेख गर्न अनुमति चाहान्छु ।

२०६४ श्रावण मसान्त (गत आ. व. को अन्त्य) सम्मको Opening बैंक मौजाद रु. २१,३४,३१७।८२

यस आ. व.२०६४।०६५ मा भएको आम्दानी र खर्च

आम्दानी	रु. ९,६८,४८०।६३
खर्च	रु. ८,३२,४१९।२२
खर्च भन्दा बढी आम्दानी	रु. १,३६,०६१।४१

यस वर्षमा भएका आम्दानीहरूमा 5th Nepal Geological Congress का लागि Contribution तथा रजिष्ट्रेशन वापत रु. ८,४५,४७३। आम्दानी भएको छ ।

यस Contribution मा ठूलो धनराशि रु. ३,१८,५००। Cairn Energy PLC, UK ले सहयोग गरेको छ । यस वाहेक प्रमुख अन्य आम्दानीमा Journal sale बाट रु. २७,७७६। Life members तथा अन्य Membership Fee वापत रु. ६४,२०० र अन्य आम्दानी रु. ३१,०३१। ६३ रहेको छ ।

1. 5th Nepal Geological Congress expense = Rs. 5,44,671.16
2. Publication Vol. 33, 35, 36, Bull. Vol. 24 = Rs. 1,33,504.0
3. Society Renewal = Rs. 9,605
4. Remuneration / wages = Rs. 17,500
5. Account and others = R. 10,000
6. Miscellaneous exp. = Rs. 44,259.47
 (Bank charge fuel photo, tax on interest etc.)
7. Communication = Rs 22,399.15
 (Telephone जडान website, email internet telephone bill)
8. Computer + accessories = Rs. 50,480.00

यस प्रकार, Income over expenditure Rs. 1,36, 061.00 रहन गएको छ, आगामी वर्षहरूमा हुने आम्दानीहरूमा Bulletin advertisement collection, new membership fee, Journal sales आदि रहने छन । संक्षिप्तमा हेर्दा समाजसँग हाल नगद Closing Balance जम्मा रु. २३,६८,३८३।४२ रहेको छ ।

अत: आर्थिक दृष्टिकोणले हेर्दा यो वर्ष समाजका लागि सन्तोषजनक वर्षको रुपमा हेर्न सकिन्छ ।

अन्त्यमा, यो विवरण सदस्यज्यूहरू समक्ष प्रतिक्रिया तथा सुझावका लागि अपेक्षा गर्दछु ।

धन्यवाद ।

धर्मराज खडका
कोषाध्यक्ष
नेपाल भौगर्भिक समाज
२०६५।५।२

Best wishes
To
Nepal Geological Society

NEPAL ELECTRICITY AUTHORITY
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Auditor's Financial Report (FY 2064/65 B.S.)

Babu Raja Bajracharya
Registered Auditor

2nd Bhadra 2065 - 5 - 2

The Members
Nepal Geological Society
Kathmandu.

Gentlemen,

I have audited the attached Receipt and Payment Account for the year ended 31st Asar 2065 and report as follows:

1. I have got all the information and explanations which are required for the purpose of audit.
2. Proper books as required are maintained according to Society's Rule & Regulations.
3. The attached Receipt and Payment Account and Income and Expenditure Account are drawn properly up in accordance with records which are made available.
4. According to the information given to me the attached Income and Expenditure Accounts prepared for the year ended 31st Asar 2065 exhibit true and fair view.

Babu Raja Bajracharya
Registered Auditor

116 Teenkune Marga, Kuleswor, Kathmandu
Phone : 4282390

NEPAL GEOLOGICAL SOCIETY
INCOME AND EXPENDITURE ACCOUNT
For the year ended 31st Asar 2065

EXPENDITURE	AMOUNT	INCOME	AMOUNT
To Advance	5,000.00	By Associate Membership Fee	3,500.00
To Advertisement	9,605.00	By Contribution	619,650.00
To Audit Fee	5,000.00	By Entrance Fee	3,850.00
To Bank Charge	2,450.00	By Interest received	12,443.71
To Communication	22,399.15	By Interest received ($262.59)	17,987.42
To Computer & Accessories	50,480.00	By Journal Sale	27,776.00
To Fuel	7,734.75	By Life Membership fee	55,000.00
To Hospitality	410,923.95	By Membership Fee	1,850.00
To Membership Fee	1,000.00	By Miscellaneous Income	600.00
To House Rent	12,995.00	By Registration	225,823.50
To Photo & Video	12,000.00		
To Photocopy	3,444.65		
To Postage	5,938.00		
To Printing	133,504.00		
To Registration & Renewal	510.00		
To Remuneration, wages	17,500.00		
To Seminar Bag	95,000.00		
To Stationary	17,430.00		
To Tax	4,055.00		
To Tax on interest	1,115.16		
To Tax on interest ($35.03)	2,399.56		
To Transportation	11,935.00		
To Excess of income over expenditure	136,061.41		
Total	**968,480.63**	**Total**	**968,480.63**

Note : US $ 1 = NRs.68.50

Treasurer	General Secretary	President	Auditor
D.R. Khadka	D.P.Adhikari	M.R.Dhital	B.R. Bajracharya

NEPAL GEOLOGICAL SOCIETY
RECEIPT AND PAYMENT ACCOUNT
For the year ended 31st Asar 2065

RECEIPT	AMOUNT	PAYMENT	AMOUNT
To Associate Membership Fee	3,500.00	By Advance	5,000.00
To Bank (opening)	2,134,317.82	By Advertisement	9,605.00
To Contribution	619,650.00	By Audit Fee	5,000.00
To Entrance Fee	3,850.00	By Bank Charge	2,450.00
To Interest received	12,443.71	By Communication	22,399.15
To Interest received ($262.59)	17,987.42	By Computer & Accessories	50,480.00
To Journal Sale	27,776.00	By Fuel	7,734.75
To Life Membership fee	55,000.00	By Hospitality	410,923.95
To Membership Fee	1,850.00	By Membership Fee	1,000.00
To Miscellaneous Income	600.00	By House Rent	12,995.00
To Registration	225,823.50	By Photo & Video	12,000.00
To Difference in $ Rate	98,004.19	By Photocopy	3,444.65
		By Postage	5,938.00
		By Printing	133,504.00
		By Registration & Renewal	510.00
		By Remuneration, wages	17,500.00
		By Seminar Bag	95,000.00
		By Stationary	17,430.00
		By Tax	4,055.00
		By Tax on interest	1,115.16
		By Tax on interest ($35.03)	2,399.56
		By Transportation	11,935.00
		By Balance	
		Agri. Dev. Bank (Fixed)	55,000.00
		Agri. Dev. Bank (Saving)	7,640.06
		Nabil Bank ($23516.38)	1,610,872.03
		Nabil Bank (Fixed)	29,000.00
		Nabil Bank (Saving)	602,020.53
		Nepal Bank (Current)	9,949.68
		Nepal Bank (Saving)	53,901.12
Total	**3,200,802.64**	**Total**	**3,200,802.64**

Note : US $ 1 = NRs.68.50

Treasurer	General Secretary	President.	Auditor
D.R. Khadka	D.P.Adhikari	M.R.Dhital	B.R. Bajracharya

SILT Consultants (P.) Ltd.

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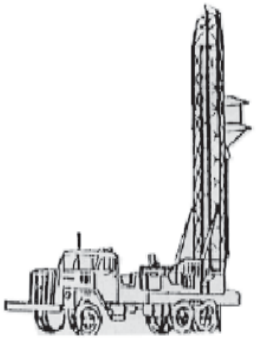
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NEPAL GEOLOGICAL SOCIETY
TRIAL BALANCE
For the year ended 31st Asar 2065

ACCOUNT HEAD	AMOUNT	ACCOUNT HEAD	AMOUNT
Advance	5,000.00	Interest received	12,443.71
Advertisement	9,605.00	Interest received ($262.59)	17,987.42
Audit Fee	5,000.00	Membership Fee	1,850.00
Bank Charge	2,450.00	Associate Membership Fee	3,500.00
Communication	22,399.15	Contribution	619,650.00
Computer & Accessories	50,480.00	Entrance Fee	3,850.00
Fuel	7,734.75	Registration	225,823.50
Hospitality	410,923.95	Journal Sale	27,776.00
Membership Fee	1,000.00	Life Membership fee	55,000.00
House Rent	12,995.00	Miscellaneous Income	600.00
Photo & Video	12,000.00	Bank (opening)	2,134,317.82
Photocopy	3,444.65	Difference in $ Rate	98,004.19
Postage	5,938.00		
Printing	133,504.00		
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Nabil Bank (Fixed)	29,000.00		
Nabil Bank (Saving)	602,020.53		
Nepal Bank (Current)	9,949.68		
Nepal Bank (Saving)	53,901.12		
Total	**3,200,802.64**	**Total**	**3,200,802.64**

Note : US $ 1 = NRs.68.50

Treasurer
D.R. Khadka

General Secretary
D.P.Adhikari

President
M.R.Dhital

Auditor
B.R. Bajracharya

नेपाल भौगर्भिक समाजको विशेष साधारण सभा २०६५

नेपाल भौगर्भिक समाजको विशेष साधारण सभा २०६५ समाजको तेह्रौं कार्यसमितिको अह्वाानमा ३० औं साधारण सभाको रूपमा मिति २०६५ पौष १४ गते (२९ डिसेम्बर २००९) सोमवारका दिन समाजका अध्यक्ष डा. मेघराज धिताल ज्यूको सभापतित्वमा खानी तथा भू-गर्भ विभाग, लैनचौरको सभाहलमा बस्यो। उक्त सभामा करिब एकशय जना सदस्य ज्यूहरूको सहभागिता थियो। कार्यक्रमको शुभारम्भमा समाजका महासचिव डा. दण्डपाणि अधिकारीले स्वागत मन्तव्यका साथै विशेष साधारण सभा बोलाउनुको औचित्य बारे प्रकाश पार्दै सभाको कार्यसूचि प्रस्तुत गर्नुभयो र उक्त सूचि उपर उपस्थित सदस्य ज्यूहरूले छलफल गर्नु भयो। सभाको कार्यसूचि र विशेष साधारण सभाले गरेका निर्णयहरू निम्न अनुसार छन्।

१) समयानुकूल नेपाल भौगर्भिक समाजको विधानमा परिवर्तन :

(क) घडेरी खरिद-बिक्रीको अधिकार :

नेपाल भौगर्भिक समाजलाई आफ्नो भवन निर्माणको लागि घडेरीको आवश्यकताको महसुस र खोजी भइरहेको तर समाजको तत्कालीन विधानले खरिद-बिक्री गर्ने अनुमति नदिने भएकाले त्यस उपर निर्णय होस् भनी राखिएको प्रस्तावमा छलफल हुँदा उपस्थित सम्पूर्ण सदस्य ज्यूहरूले घडेरी खरिद-बिक्री गर्न पाउनु पर्ने आवश्यकता ठहर गरी सोही अनुसार विधान संशोधन गर्ने निर्णय गऱ्यो।

(ख) कार्यकारिणी समितिको पदावधि :

नेपाल भौगर्भिक समाज कार्यकारिणी समितिको पदावधि ३ वर्ष भएको र समाजका सदस्यहरूबाट २९ औं वार्षिक साधारण सभाको समयमा ३ वर्ष हुँदा विविध कुराहरूले गर्दा असजिलो भएकोले २ वर्षको बनाउनु पर्ने भन्ने विचारहरू प्रस्तुत भएको हुँदा त्यस सम्बन्धि सुझाव संकलन गर्नको लागि समाजका पूर्व अध्यक्ष अच्चुतानन्द भण्डारी ज्यूको अध्यक्षतामा बनेको नियम-विनियम उपसमितिलाई कार्यसमितिको निर्णय अनुसार पहिलेनै सुझाव संकलन गर्ने जिम्मा दिइएको थियो। उक्त समितिको अध्यक्ष श्री अच्चुतानन्द भण्डारी ज्यूले सभामा उपस्थित सदस्यहरूलाई २ वर्ष अथवा ३ वर्षको पक्षमा हात उठाई मत व्यक्त गर्न अनुरोध गर्नु भयो र बहुसंख्य सदस्यहरू पदावधि २ वर्षको गर्नुपर्ने पक्षमा देखिएकोले कार्यसमितिको पदावधि २ वर्षको हुने निर्णय गरियो।

(ग) सम्मानित सदस्यको संख्या :

समाजको कार्यसमितिको सिफारिसमा र साधारण सभाको निर्णयमा बढीमा १५ जनासम्मलाई सम्मानित सदस्यता प्रदान गर्न सकिने भनि विधानमा उल्लेख भएको र हालसम्ममा ११ जनालाई सम्मान गरिसकेकोले तोकिएको संख्या अमिल्दो देखिएको हुँदा त्यसलाई परिवर्तन गरी वर्षको बढिमा २ जनासम्मलाई सम्मानित सदस्यता प्रदान गर्न सकिने भनि निर्णय गरियो।

माथि उल्लेखित निर्णयहरू गर्ने क्रममा पूर्व अध्यक्ष ज्यूहरू तथा अन्य सदस्यहरू र तेह्रौं कार्यसमितिका पदाधिकारीहरूले छलफलमा सक्रियतापूर्वक भाग लिनुभएको थियो। अन्त्यमा समाजका अध्यक्ष डा. मेघ राज धितालले आफ्नो मन्तव्य सहित विशेष साधारण सभा समापन भएको घोषणा गर्नुभयो।

उक्त समाजको विशेष साधारण सभा संचालन हुनुभन्दा पहिले सोही स्थानमा समाजका सम्मानित सदस्य, स्विटजरल्याण्डका नागरिक Dr. Jovan Stöcklin ले नेपाल हिमालयमा भौगर्भिक अनुसन्धानमा दिनुभएको योगदानको कदर सहित दिवङ्गत आत्माको चिर शान्तिको कामना गर्दै शोकसभाको आयोजना गरियो।

HIGHLIGHTS OF INTERNATIONAL STRATEGY FOR DISASTER RISK REDUCTION (ISDR) DAY-2008

WORKSHOP ON KOSHI DISASTER OF 2008

On the occasion of ISDR-Day 2008

Inaugural speech by Honorable Deputy Prime Minister and Minister of Home Affairs, Mr. Bamdev Gautam

अध्यक्ष ज्यू

आयोजक संस्थाका अध्यक्षज्यूहरू

महिला तथा सज्जनबृन्द !

मलाई यस अन्तर्राष्ट्रिय प्रकोप न्यूनीकरण (ISDR-DAY) २००८ को अवसरमा आयोजना गरिएको यस कार्यशाला गोष्ठीको उद्घाटन गर्न तथा यस सभामा आफ्ना विचारहरु राख्न पाउँदा खुशी लागेको छ। यस अवसरमा यो कार्यशाला आयोजक समितिलाई धन्यवाद दिन चाहन्छु।

बिगतमा झैं यस बर्ष पनि विभिन्न संघ संस्थाबाट जनचेतना जागर ण सम्बन्धि कार्यशालाबाट प्राकृतिक प्रकोप सम्बन्धि सजगता,उद्धार र राहत सम्बन्धि कार्यमा सहयोग पुगेको पनि म स्मरण गराउन चाहन्छु।

यसै सिलसिलामा संयुक्त राष्ट्रसंघबाट प्रस्तावित अन्तर्राष्ट्रिय प्रकोप न्यूनीकरण अभियान एक यस्तो कार्यक्रम हो जहाँ सबै समुदायका सदस्यहरु आ-आफ्नो सिप र क्षमता अनुसार प्रकोप बाट हुने जन धनको क्षति न्यूनीकरण गर्न एकिकृत हुन सक्छन जसबाट न्यूनीकरण कार्यमा सकीय योगदान पुग्नेछ।

हामी सबैलाई थाहै छ नेपाल यहाँको भौगर्भिक तथा भौगोलिक अवस्था, भिरालोपना, विविध खालको हावापानी, मौसम आदि सम्बन्धित प्रकोप बाट जोखिमपूर्ण छ। यहां विशेष गरी उच्च हिमाली भेगमा हिमपहिरो तथा हिमताल विस्फोटबाट असर गर्छ भने अन्य भागमा आगलागि बाढी-पहिरो र भूकम्पबाट असर गर्दछ। यस्ता प्रकोपहरूबाट राष्ट्रिय अर्थतन्त्रमा ठूलो क्षति तथा व्यय भार पर्दछ।

प्राकृतिक प्रकोपको दृष्टिबाट हेर्दा अन्य देशहरू जस्तै नेपाल पनि एक प्राकृतिक प्रकोपबाट बर्षेनी असर पर्ने देशहरूको समुहमा पर्दछ भन्दा अत्युक्ति नहोला। यहाँका जनताहरूलाई प्राकृतिक प्रकोपको चपेटा सँगै बाँच्नु परेको छ। यस्ता सबैखाले प्राकृतिक प्रकोपका असरले देशको विकास, यहाँको वातावरण र जनस्वास्थ्यमा प्रतिकूल प्रभाव पारिरहेको छ।

त्यसर्थ यो वर्षको संयुक्त राष्ट्रसंघको नारा "Hospitals safe from Disaster" र यहाँको अत्यन्त दुःखदायी घटना "Koshi Disaster" सम्वन्धी कार्यशाला हाम्रो लागि उत्तिकै सान्दर्भिक छ। यस्तै खाले प्रकोपले सुदुरपश्चिममा पनि उत्तिकै प्रभाव पारेको छ।

यस सन्दर्भमा प्रकृतिसंग सम्बन्धित प्रकोपहरूको निराकरण सहज नभए पनि समय र परिस्थिति अनुकुलहुने वैज्ञानिक तथ्यमा आधारित स्थानीय प्रविधिहरूको प्रयोग र तत्ससम्बन्धी जनचेतनाबाट प्रकोप न्यूनीकरणमा सहयोग पुग्ने छ।

हामीलाई आशा छ, आजको यस कार्यशालामा हुने अन्तरकृयाबाट अहिले भएका र भविष्यमा हुनसक्ने प्रकोप न्यूनीकरणमा ठूलो योगदान पुग्ने ठोस निश्कर्षहरू आउनेछन्।

यो सकारात्मक कुरा हो कि विभिन्न विधाहरूसँग सम्बन्धित संस्थाहरू एकसाथ जुटी प्रकोप न्यूनीकरणमा सकृय रुपमा कार्यरत भई जनचेतना जगाउने कार्यमा योगदान दिइरहेका छन। भविष्यमा पनि यस्ता कार्यहरूमा एकजुटभई सकृय रहने छन् भन्ने कामना गर्दछु।

धन्यवाद !

Glimps of the Koshi Disaster Workshop

Background

In the Hindu Kush–Himalayan region and elsewhere, catastrophic floods and debris flows have significantly increased in their magnitude and frequency since last several decades. There have been severe floods in the Indus, Ganges, and Brahmaputra Rivers. This increase can be attributed to climate change and other anthropogenic factor. The Bagmati flood disaster of 1993 in central Nepal was one of such examples when the Bagmati barrage was severely damaged and about 1500 people lost their lives.

Some of these catastrophic floods have a trans- boundary nature when the problem is initiated in one country and the loss of lives and property is also severe in the downstream areas belonging to another country. A similar trans- boundary flood was experienced in Nepal and India on 18 August 2008, when the channel shifting of the Koshi River created an unprecedented flood disaster responsible for a huge loss of lives and property in both the countries. The workshop was organised to mark the International Strategy for Disaster Risk Reduction (ISDR)–Day 2008, and it focused on the technical, humanitarian, environmental, and social issues of the Koshi Disaster of 2008.

Aims and Objectives

Though there have been efforts toward rescue and rehabilitation of the population within the Koshi disaster zone, a comprehensive assessment of the problem including its historical background and future scenarios in a multidisciplinary and integrated manner had not been taken up yet. Hence, this workshop intended to bring together various specialists involved in the assessment of the Koshi disaster of 2008. The participants shared experiences with the specialists and the observations, findings, and recommendations of the Workshop were communicated to the Nepal Government, other concerned agencies, organisations and media. It was also planned to publish the material of the Workshop in the Bulletin of Nepal Geological Society.

Chief Guest

Honorable Deputy Prime Minister and Minister for Home Affairs, Mr. Bamdev Gautam

Programme Venue

Russian Cultural Centre, Kamal Pokhari, Kathmandu

Date

22 October 2008 (6 Kartik 2065, Wednesday)



Photo 1: Honourable Deputy Prime Minister participating in the inaugural function of Workshop on Koshi Disaster 2008, on the occasion of ISDR-Day 2008



Photo 2: Honourable Deputy Prime Minister graciously inaugurate the Workshop on Koshi Disaster 2008, on the occasion of ISDR-Day 2008



Photo 3: Participants of Workshop on Koshi Disaster 2008, on the occasion of ISDR-Day 2008

ABSTRACTS OF PAPERS PRESENTED IN WORKSHOP ON KOSHI DISASTER OF 2008
On the occasion of ISDR-Day 2008

Bridging the gap between civil society and the government on Koshi Disaster

Ananda Prasad Pokharel
Koteshwor, Kathmandu

Introduction

Koshi is a large river of eastern Nepal. It flows into India to join the Ganges. Seven rivers flow together out of the eastern Himalaya to create the Sapta Koshi River. The seven rivers are the Indrawati, Bhote Koshi, Tama Koshi, Dudh Koshi, Likhu, Arun, and Tamor. The Sapta Koshi River flow is controlled by a system of levees or embankments designed to control flooding and provide irrigation, and an adjustable dam at the Koshi Barrage at the Nepal-India border.

Agreement on Koshi Project and its situation

As per the Koshi agreement in 1954, which was later revised in 1966, the 1,100-metre barrage has been built with 32-km embankment and 57 spurs to direct excess water flow towards centre of the river instead of banks in the eastern side (near Sunsari) and another 25-km in the western side of the embankments that consist of 41 spurs. The Indian government is responsible for its maintenance and operation. Though the length of each spur was around 200–300 m at the time of the construction, it has now been reduced to less than 50 m.

The condition of the embankments is very poor. Besides, river training structures were never maintained to meet the original standard. The Koshi treaty, the overall responsibility of managing and maintaining the barrage and embankments lies with India. The river went into flood because its eastern embankment was not properly maintained and thus got washed away easily. The discharge of the Koshi during that time was less than 200,000 cusec, far less than the 400,000 cusec of previous years.

Negligence of Indian and Nepalese Authorities

Had the embankments been maintained properly, such a large human tragedy could have been avoided. It is, therefore, natural to blame India for not abiding by the agreement and keeping the embankment in good repair.

It is also the responsibility of the host country Nepal to cooperate, coordinate and ensure that the embankment is maintained. It should have initiated appropriate measures in time to prevent the disaster.

The government has failed to reduce the risk. Despite knowing that the embankment was going to fail, it took no action to shift the inhabitants to safer places. There was no flood warning system, and the people were asleep at their homes when the fury of the Koshi struck them with full force at midnight. Rescue and relief operations got delayed while the major political parties engaged in power sharing deals. Political equations were more important to them than the plight of drowning citizens. The government has not declared a state of emergency, and the Koshi flood has not been recognized as a national tragedy

Controversy of Koshi Treaty

The controversy started right after the treaty was signed between the Indian and Nepalese officials. The Nepalese people are divided; for and against the treaty.

Demands of Nepalese

- Revisit the Koshi Treaty and update and improve
- Develop the proper mechanism for joint operation, maintenance and management
- Work with mutual trust and meaningful participation
- Activation of Joint Committee on water resources

- High-Level Technical Committee on Koshi
- Provide compensation to affected people of Nepal
- Resettlement of flood's victims.

Role of civil society to solve the problem

- Construction network of likeminded NGOs and INGOs for advocacy of Koshi disaster
- Empowerment of affected people and construction of national network
- Campaign for public awareness regarding floods
- Demonstration from flood victims to give pressure to the government to review the Koshi Treaty
- To publish the facts and figures about the destructions lives and properties
- Raise the voice in international forum
- Advocacy between civil society and related ministry in the matter of disaster
- Lobbying in between the government and MPs for revisiting of the treaty
- Empowerments of people to make strong institution
- Mobilisation of political parties for this matter
- Organise interaction program between parliamentarian and parliamentary party
- To make all party network to pressurise concerning ministry and make it the national agenda
- Organise the signature campaign to pressurise the government about the matter
- Mobilisation of media

Role of MPs

- MPs must be aware about the Treaties and agreements
- Advocating in and out of parliament regarding bilateral and multilateral treaties and agreements
- Know the facts and figures of the nation
- Must have knowledge about international treaties protocol and other commitment done by the nation
- Make a lobby group of likeminded MPs
- Should start a discussion in every parliamentary party
- To pressurise the government
- MP can submit the parliament adjourn proposal for revisiting of treaties
- MP can submit the attention proposal in parliament for concern ministry
- MP can submit the Sankalpa proposal in parliament to attract the national attention

Role of Government

- Reviewing each and every treaty and agreement done with India
- Revisiting the treaties with national interests
- To form all party common consent in national interest
- Studies of all river basins; Koshi and Gandak treaties
- To forbid India to construct unauthorized barrage in southern border
- To conduct national campaign for flood control with infrastructures
- To start a campaign to minimize the effect of climate change

Conclusion

Resolution of Koshi flood problem is an enormously great challenge for Nepal as well as India. The treaty should be revisited for the mutual benefits of both countries. Multipurpose project should be constructed with international standard in benefits of Nepalese people.

Koshi Flood 2008: realities on hydro-meteorology and sediment

J. K. Bhushal and D. Pradhananga
SOHAM-Nepal

The recent Koshi deluge with the break of Koshi dam in the eastern part on August 18, 2008 has displaced more than 60,000 people in Nepal. At least eight villages have been badly affected. The national highway has also been damaged at several places by the flood. On August 21, more than 22 dead bodies were recovered in the vicinal village in India.

The hydro-meteorological analysis reveals that the breach was not due to the hydrological and meteorological extremes. The discharge at Chatara was 4400 m^3/s and that at the Koshi Barrage was 4800 m^3/s during the breach time whereas the design discharge of the Barrage is 27,014 m^3/s. However, sediment inflows and deposition can not be ignored. The breach could be mainly due to weak spurs and embankments and their poor maintenances. In addition only 34 out of 58 gates were opened on the day of breach.

A study on the media coverage of Koshi flood and local people's perception after flood: a case of spur brust at Koshi dam on 18 August 2008

Nabin Aryal and Rishi Acharya

The spur burst of the Koshi flood on 2 Bhadra 2065 B.S. victimised a wide area affecting people, properties and the environment. The Koshi flood became a topic of national debate immediately after the event and the news dominated the media for several days. But, the genuine information about the flooding event was however not sufficiently covered due to the inefficient government attention in assisting media to make the news in the reach of people widely. From the Koshi flood lives, property, and environment could not be saved because of inadequate disaster forecasting and weak governance mechanism of Nepal. It is evident that with the onset of Democracy in 2046 the media has played a crucial role in improving the level of information, education and technical skills. However, the proper attention has not been given in the sector of disaster management and minimization of loss in the post disaster scenario through the media. The study focused on the media coverage of the Koshi flood disaster at central and local level, including the local people perception after flood. The paper assesses the difficulties faced by the media during the broadcast of news of any disastrous event like "Koshi Flood". One week of field observation and questionnaire survey in different media tends to recommend the proper approaches in covering the news of disaster, mitigation plans through mass media, and awareness programs on disaster in pre-disaster stage.

ARTICLES

ABSTRACT OF PAPERS PRESENTED IN THE SCIENTIFIC TALK PROGRAMMES

Neotectonics of the India-Asia collision zone: insights from tectonic stress modelling

Deepak Chamlagain
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The collision zone between India and Asia, which is characterized by diffuse zone of deformation, is the best example to study continental tectonics in terms of neotectonics, seismicity, tectonic stress field, and plate kinematics. The Himalaya-Tibet orogen, a product of continental collision, demonstrates complex contemporary tectonic stress pattern that reflects present-day geodynamics of the region. Recently, World Stress Map (WSM) project has presented an extensive data set on stress field for the Himalayan-Tibet region. Zhonghuai et al. (1992) and the data base produced by WSM have shown mean principal stress axes for the Himalaya-Tibet orogen. Inferred P and T axes are dominantly horizontal and the intermediate (B-axes) are vertical indicating deformation primarily takes place through strike-slip faulting in the Tibetan Plateau and surrounding areas except Himalayan region. These data further suggest that the principal stress axes have a relatively uniform radial pattern. The maximum horizontal compressive stress (S_{Hmax}) trajectories radiate from the Tibetan Plateau to the northern, eastern, and southeastern part. However, the minimum horizontal compressive stress direction is almost arc convex outward from the Tibetan Plateau. In the western part of the Tibetan Plateau near the Tian Shan, maximum horizontal stress axes are northwesterly oriented and minimum stress axes are vertical indicating thrust faulting regime. For the Himalayan region their data are limited and sparse, however, eastern and western syntaxes show sharp bending of stress trajectories towards southeast and northwest direction respectively.

In this study, neotectonics of the entire collision belt has been studied taking S_{Hmax} as a proxy. Two-dimensional plane stress modeling has been carried out under elastic rheology. This approach is almost analogous to thin sheet modeling. Modeling results have confirmed that the kinematics equivalent to east-west tectonic escape did not simulate the observed stress field, therefore, it is understood that the present day stress field is mainly governed by the southeastward tectonic escape of the Tibetan crust rather than eastward extrusion. This fact is further supported by observed GPS velocity vectors. Models without suture zone and associated faults produced the best-fit stress field in the region. Considering this fact, 'continuum tectonic model' is proposed for the active deformation of the Himalaya-Tibetan orogen rather than 'block tectonic model'.

Current status of discontinious mountain permafrost in the Nepal Himalaya

Dhananjay Regmi

Permafrost in Nepal has received very little scientific attention, despite the fact that Nepal is a country known for the Himalaya. Even the distribution of permafrost in Nepal has not been clarified yet. This study deals with the distribution of rock glaciers and permafrost in five high Himal areas of the Nepal Himalaya: Kangchenjunga, Khumbu, Langtang, Annapurna, and Sisne. Permafrost is an invisible phenomenon and its presence is difficult to identify. Therefore, an indicator landform of rock glaciers was used for aerial photograph interpretation to identify the present distribution of permafrost in five areas. Field observations were also made in order to check the rock glaciers in three areas of Kangchenjunga, Khumbu, and Langtang. First, rock glaciers of periglacial-origin and those of glacial-origin were mapped; and then size, altitude, and aspect of each periglacial-origin rock glaciers were analyzed by GIS. The results show that: (1) High amount of precipitation in eastern Nepal leads to the development of glacier-origin rock glaciers; (2) the size of the rock glaciers tends to decrease from the east (Kangchenjunga) to the west (Sisne); (3) the mean altitude of rock glaciers decreases towards the west; and (4) the aspects of the rock glaciers are variable, but southerly directions are most common.

Intensive field surveys were carried out at three sites in Langtang Himal (Yala, Gangja La and Helambu) to examine the relationship between permafrost distribution and geomorphological arrangement. Altogether, 140 seismic surveys, 9 ground temperature profile measurements, and 48 BTS (Bottom Temperature of Snow) surveys were conducted. The results obtained from each method were then crosschecked to minimize potential errors. The combined results from the three methods show that (1) the altitudes of the lower limit of the permafrost lie at 4,740 m at Yala site, at 4,820 m at Gangja La site, and at 4,670 m at Helambu site; (2) permafrost occurs in areas adjacent to rockwalls and in moraine areas where the glaciers have been retreating rapidly; and (3) the permafrost areas lie within the horizontal distance of about 300 m from the base of the rockwalls, whereas they lie within the distance of about 700 m from the glacier termini.

The foregoing results on the relationship between the permafrost area and debris-accumulated areas suggest a possibility that the permafrost development is strongly related to the debris supply, such as rockfall. Rockfall activities and exposed bedrock thermal regime were monitored and evaluated at altitudes between 4,600 m and 6,000 m in Kangchenjunga Himal. Effective freeze-thaw cycles were first calculated from measured rockwall temperatures at different altitudes, and then, the exposed rockwall area was analyzed by GIS. The results show that: (1) the south-facing rockwalls experience frequent diurnal freeze-thaw cycles, while the north-facing rockwalls are characterized by seasonal freeze-thaw cycles; (2) the south-facing rockwalls have greater number and amount of rockfall than the north-facing rockwalls; and (3) the altitudinal belt responsible for the rockfall activities ranges from 5,400 m to 6,000 m on the south-facing rockwalls, and from 5,000 m to 5,600 m on the north-facing rockwalls.

Finally, factors responsible for deciding the size, altitude, and aspect of the rock glaciers in the Nepal Himalaya were discussed focusing mainly on the debris supply regimes from adjacent rockwalls. Summer precipitation water experiences freezing and thawing to expand cracks of the rockwall surface, so that more rockfall debris is produced; therefore, the concurrence of the effective freeze-thaw cycles and the large exposed rockwall area, especially of southerly directions, is considered as the major controlling factor for the development of the permafrost including rock glaciers.

Geochemical studies of sediments and water, and implications for mobilisation of arsenic into groundwater in Nepal and Japan

Jaya Kumar Gurung

This study evaluates geochemistry of sediments and water relevant to arsenic in the Kathmandu Basin and Terai Plain of Nepal. The elements analyzed include major oxides (Fe_2O_3, TiO_2, CaO, and P_2O_5), total sulfur (TS), trace elements (As, Pb, Zn, Cu, Ni, Cr, V, U, Th, Sc, Y, Nb, Sr, Zr, Br, and I), and rare earth elements (REE: La, Ce, Sm, Eu, Gd, Tb, Yb, and Lu). Physical and chemical properties of water samples were determined using field kits and laboratory tests. Similar geochemical study has been carried out in Yumigahama Peninsula (Tottori), and comparison is made with those results. In addition, selected core samples were treated with alkali, acid and deionized water to extract arsenic in different pH conditions. Carbon (^{14}C) dating of shell and wood fragments was also made. Nitrogen isotope ($ä^{15}N$) ratios of selected water samples were also determined.

In the Kathmandu Basin the average bulk concentrations of the major oxides and trace elements of sediments are similar to modern unconsolidated sediments. However, variations in elemental abundances within the basin are strongly controlled by sediment facies, with higher concentrations in finer size grades. The marginal basin consists dominantly of coarser sediments (sand and gravel) and finer sediments such as silt and clay occurs towards the basin center. The grain size variation in the basin influences underground redox conditions, with the deeper and central basin more reduced than the marginal basin. The sediment chemistry of the Terai Basin is comparable to the Kathmandu.

The water chemistry results overall suggest that redox conditions and organic matter contents are likely to be more significant as a cause of elevated arsenic in both Kathmandu and Terai Basin groundwater than the bulk arsenic concentration in the sediments. The characteristics of the water chemistry are neutral pH, positive correlation between arsenic and iron contents, and negative correlation between oxidation reduction potential and arsenic. One contrast in groundwater chemistry between As-rich and As-poor areas is the level of nitrate (NO_3^--N). Arsenic-poor groundwater is frequently contaminated with high nitrate (>45 mgNO_3/l) in all three study areas. Nitrate isotope ratios are higher ($ä^{15}N$ >20%) than in common nitrogen

sources in soils. Higher rate of volatilization, high organic matters activities, and faster rate of denitrification rate are the potential reasons for such a high nitrogen isotope ratios. Extraction analyses demonstrated that As is significantly eluted under acidic, neutral or alkaline pH conditions. This suggests that arsenic is most likely fixed in the sediments in several forms, such as organic matter, carbonates, and iron oxides. However, it is difficult to explain which form is responsible to elucidate the behavior of arsenic in such diverse underground redox conditions.

Organic matter likely augments arsenic dissolution from sediments. Frequent change in spatial sedimentary facies is noteworthy in all three study areas, and this may affect groundwater movement, which in turn may influence the spatial variation of arsenic in groundwater. Low oxidation-reduction potential is a likely condition for arsenic release, and ground water flow plays a role in As mobilization owing to flushing and attenuation effect.

Qualitative kinematic investigations related to the extrusion of the Higher Himalayan Crystallines and equivalent tectonometamorphic wedges in the central Nepal Himalaya

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Located in the central Himalayan collisional wedge, the Kathmandu Nappe is a >100 km broad re-entrant in the regional tectonostratigraphy. The tectonostratigraphic package includes the orogen-wide renowned Main Central Thrust (MCT), regarded by many as the main (i.e. crustal-scale) thrust-kinematics deformation zone in the Himalaya that, regionally, juxtaposes the Lesser Himalaya (footwall) with the Higher Himalaya (hanging wall).The entire re-entrant feature has a syn-formal architecture (the Mahabharat Synclinorium) thereby the regional tectonostratigraphic foliation is S-dipping on the northern flank. Differing interpretations question (1) whether the MCT (either the main deformation belt or some lithostratigraphic contact) continues along strike (and cuts across), or runs parallel with, the re-entrant and (2) whether the MCT is really the key crustal thrust in the Himalaya (e.g. based upon detrital provenance geochronological arguments).

To address these questions, ten swath profiles across the nappe have been chosen to identify the timing and amount of strain associated with major lithospheric thrusting around the Kathmandu Nappe by using field mapping, structural surveying and detailed microstructural kinematic and strain analyses in addition to geochemistry and U-Pb, Sm-Nd and Rb-Sr geochronology/geochronometry. The zone of contact between the Nawakot Complex (Lesser Himalaya) and Kathmandu Complex (Higher Himalaya) is observed as a 100–400 m thick zone of thrust deformation. Visible intensity of strain gradually decreases away from the core of this main thrust zone. Deformation-related microstructures vary with the local protolith. The northern flank of the synclinorium is largely occupied by the Sheopuri Injection Gneiss, which forms stretched and flattened sheets and fingers within quartzite and schist of the Kathmandu Complex. In all of the area, Kathmandu Complex rocks within the thrust zone, a range of monoclinic geometry asymmetry mica micro-domains, quartz micro-ribbon features, and syn-kinematic garnets all preserve dramatic rotation history and demonstrate consistent thrust kinematics. Within the Nawakot Complex, although the intensity of strain is less spectacular than in the hangingwall, kinematic indicators again consistently demonstrate thrust sense. In both Areas, the main thrust zone also clearly marks change in metamorphic grade from the coarsely crystalline, garnetiferous biotite schist of the Kathmandu Complex to the rocks of the Nawakot Complex (dominantly metasedimentary quartzite, phyllite, slate, limestone, and dolomite that are devoid of garnet). Although the grade of metamorphism is different in these areas (In most of the area of the northern flank sillimanite grade while in the southern flank garnet grade), the visible strain and characteristics of deformation in the vicinity of the thrust are consistent.

A public downloading software Scion Image is used to analyze grains of quartz and feldspar in rocks of the Kathmandu Complex and Nawakot Complex which shows that rocks of the Nawakot Complex record monoclinic symmetry while rocks of the Kathmandu Complex record orthorhombic symmetry. In rock of the MCT zone, quartz grains show orthorhombic while feldspar grains show monoclinic symmetry. Rocks of the Kathmandu Complex and of thrust zone show higher rheological role of quartz than in rocks of the Nawakot Complex. In these rocks, shear sense indicators show both pure shear flattening fabrics and non-coaxial south-directed simple shear fabrics. Rocks of both the hanging wall and footwall show a significant

pure shear component early in the deformation and simple shear component during exhumation. Therefore, the MCT can be characterized as *Stretched Fault Thrust*.

The Sm-Nd whole rock analysis carried out in rocks of the Lesser Himalyan phyllite and amphibolite, Higher Himalyan schist and gneiss, and phyllite of the MCT zone shows a linear trend of $^{143}Nd/^{144}Nd$ vs $^{147}Sm/^{144}Nd$ plot with lowest values in the Lesser Himalayan phyllite and highest value in the Higher Himalayan gneiss. ε (0) Nd value shows a marked difference in Lesser Himalayan (>-20) and Higher Himalayan rocks (about -13 in schist and about -6 in gneiss). The Sm-Nd garnet geochronology and Rb-Sr biotite geochronology carried out in one sample of Galchhi gneiss (western extension of the Shivapure Injection Gneiss) shows young metamorphic evidence, probably during the Himalayan tectonometamorphic evolution. The rock obviously suffered intense metamorphism and subsequently cooled to below ca. 300°C at 13.5 Ma. LA-ICP-MS U-Pb geochronology was carried out on three gneisses in the vicinity of the thrust zone and one sample of granite from the core of the Kathmandu Nappe which show that, all samples were emplaced as granite around 450 Ma. Subsequently those samples which lie in the vicinity of the MCT are metamorphosed during the thrusting along the MCT. However the granite sample which lies with in the core of the HHC wedges an essentially unaffected by the MCT deformation.

Bt-Grt thermometry carried out in eleven schist and gneiss samples of the Kathmandu Complex shows that, rocks of the similar lithology and similar structure lying in the southern part of the nappe shows relatively low temperature (about 400° C) then the rocks lying in the northern part of the nappe (>500° C).

Glaciers, climate, and topography in the Annapurna Range, Nepalese Himalaya

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Snow and ice are key components of the globally-influential Himalayan-Tibetan climate system. They provide important dry-season water sources for millions of people and are tied to weather systems such as ENSO. Past Himalayan glacial fluctuations give insight into high-altitude paleoclimates that help calibrate global climate models and thus allow better predictions of future climate change. Despite compelling issues surrounding Himalayan glaciation, we know relatively little about the controls of ice modulation. In order to better constrain the controls on glaciation we combine chronology, equilibrium-line altitude (ELA) analysis, modeling, and modern climatic data from the Annapurna region, Nepal. Cosmogenic radionuclide 10Be dates provide the major age constraint. Tightly grouped ages on single moraines allow for unusually high confidence in the results. Moraine sets date to the Early Holocene intensified summer monsoon (~8 ka) and the Bølling-Ållerød chronozone (~14 ka). During the Early Holocene, southern ELAs were ~800 m lower and northern ELAs 500 m lower than today. The Bølling-Ållerød had ELA depressions of e"1000 m and 600 m, respectively. Clearly, quite different climates induce glacial advances of similar magnitude – greater than expected for post glacial maximum (<18-ka sites). Analysis of modern weather data shows that the majority of summer precipitation and winter snow falls at altitudes below the modern glaciers. Cooling of only 1-3ºC could convert significant portions of summer rain to snow and allow greater preservation of winter snow, permitting the observed glacial advances. Local climate factors of this sort have not been previously considered in ELA interpretations. Modern climate data also demonstrate that about half the annual snow, on these purportedly "summer accumulation" glaciers, falls during the winter. Thus, both summer monsoon and winter westerly fluctuations must be considered in paleoglacial interpretations. Topography can also play a key role in determining glacial behavior. Modeling and dating demonstrate that, due to hypsometric differences, climate change can cause one glacier to advance while its neighbor, experiencing the same orientation and climate, retreats.

Observations of multi-particle interactions in moderate to dense granular shear flows

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The transitional granular flow with normalized solid fraction in the range of 0.50 to 0.80 and shear rate of 14.8 s^{-1} to 34.6 s^{-1} is studied in the experiment using a 2D shear flow apparatus and with the help of image processing technique. Inter-particle collisions are detected for each particle and at each time step by formulating the new collision detection method. This method is found more promising compared to the existing methods and many of the lost collisions from the existing methods could be truly detected. The multi particle interaction phenomena like the contact durations, multiple collisions and the group size are also studied and are described in terms of shear rate and the normalized solid fraction.

It is found that the average contact duration decreases on increasing the shear rate and increases on increasing the solid fraction. Contact durations much greater than binary collision times are obtained for higher solid fractions. The multiple collision percentage in spatial terms is handled by the solid fraction, whereas its relation with the shear rate is not much clear. Occasional force chains are developed for the dense range of solid fractions studied in this study. The contact frequency increases on increasing the shear rate and the solid fraction, but the rate of increase diminishes for the higher solid fractions when a higher shear rate is applied. The shear stress also increases with shear rate and solid fraction, but the rate of increase accelerates when the normalized solid fraction is roughly greater than 0.75 and the shear rate is fairly high ($\dot{\gamma} > 24\ s^{-1}$). In such cases, shear stress varies with more than square of the shear rate. This is attributed to the increase in prolong contacts, and the development of occasional force chains in these flows because of increased interactions between more than two particles at a time. These observations therefore imply that the shear stress generation pattern differs from the existing models like that obtained from the kinetic theory of gases for transitional granular flows if the shear deformation rates are not so small.



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Causes and effects of sediment-related disaster in upper Jeneberang watershed, south Sulawesi, Indonesia

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ABSTRACT

The Jeneberang Watershed located at South Sulawesi, Indonesia, is prone to sediment-related disaster. Relatively vulnerable rocks such as pyroclastic rocks and low degree of cemented sedimentary rocks have caused mountain body collapse, affecting the Jeneberang River and Bili-Bili Dam. Intense rainfalls have triggered sediment-related disaster and created huge amount of sediments. These sediments affect the sustainability of the Jeneberang River ecosystem and harm the function of Bili-Bili Dam.

Keywords: Sediment-related disaster, geology, intense rainfall, Jeneberang Watershed, Indonasia

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INTRODUCTION

The disaster is the phenomenon that inflicts injuries upon our lives or properties (both individual and public) due to some cause or others (Ikeya 1976). Sediment-related disasters such as landslides and debris flows have brought about lots of damage to the nature in Indonesia in recent years. Since 2004, in South Sulawesi Province, sediment-related disasters such as landslides and debris flows have been considered as important issues for mitigation (Hasnawir et al. 2006). A large landslide with debris flow occurred in upper Jeneberang Watershed on Mt. Bawakaraeng Caldera and produced roughly about 232 million m^3 of sediments. The landslide was caused by the collapse of the caldera's wall. It triggered a large debris flow and eventually caused significant damages, including 32 deaths and destruction of property (Tsuchiya et al. 2004). However, 600 households are still living and doing their activities in surrounding areas. In total, from 1997 to 2007, twenty cases of landslides or debris flows have been reported in the region of Mt. Bawakaraeng Caldera. Mt. Bawakaraeng is the headwater of the Jeneberang River and the Bili-Bili Multipurpose Dam is constructed about 35 km downstream of the river. This paper focuses on general causes and effects of sediment-related disasters in the river and the dam.

LOCATION

Mt. Bawakaraeng Caldera is located 90 km away from Makassar, South Sulawesi, at an altitude of 2,830 m. The vegetation of the mountainous area is composed of natural forest and the forest plantation is dominated by *Pinus merkusi.* The catchment area of the Jeneberang River is 760 km^2 and the length of the river is about 75 km. The river flows down mainly through the Gowa district, touches few parts of the Takalar district, and finally reaches the estuary in the Makassar city. The river has dendritic drainage pattern with two branches: the Malino River in the north and the Kausisi River in the south. It stretches and converges towards the Bili-Bili Dam, at the west confluence of the Malino and Kausisi Rivers (Fig. 1).

GEOLOGY

The Basement rocks around Mt. Bawakaraeng consist of the Tonasa Formation, Camba Formation, Baturape-Cindako volcanic rocks, intrusive rocks and Lompobattang volcanic rocks formed during the Paleogene to Quaternary time. They are covered by the subsurface deposits of Holocene epoch. The geological map around Mt. Bawakaraeng is shown in Fig. 2. The morphology of Mt. Bawakaraeng is characterised

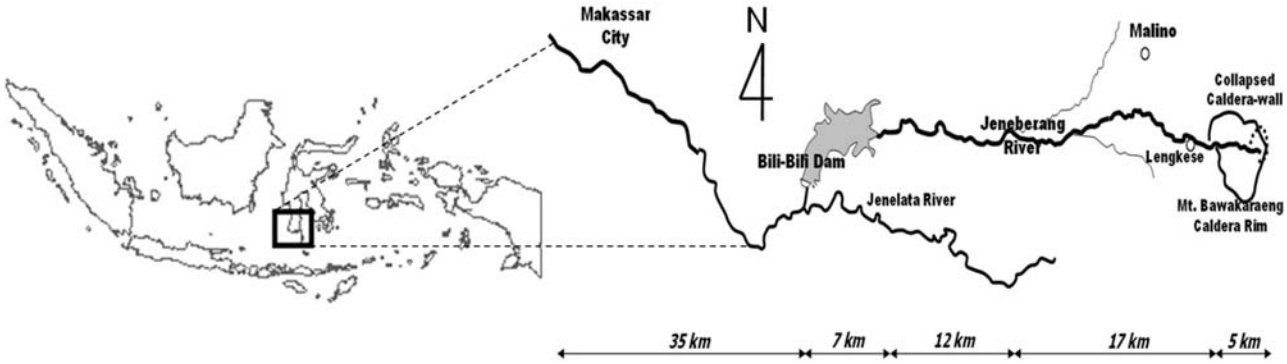


Fig. 1: Location of the Jeneberang Watershed in South Sulawesi, Indonesia

Fig. 2A

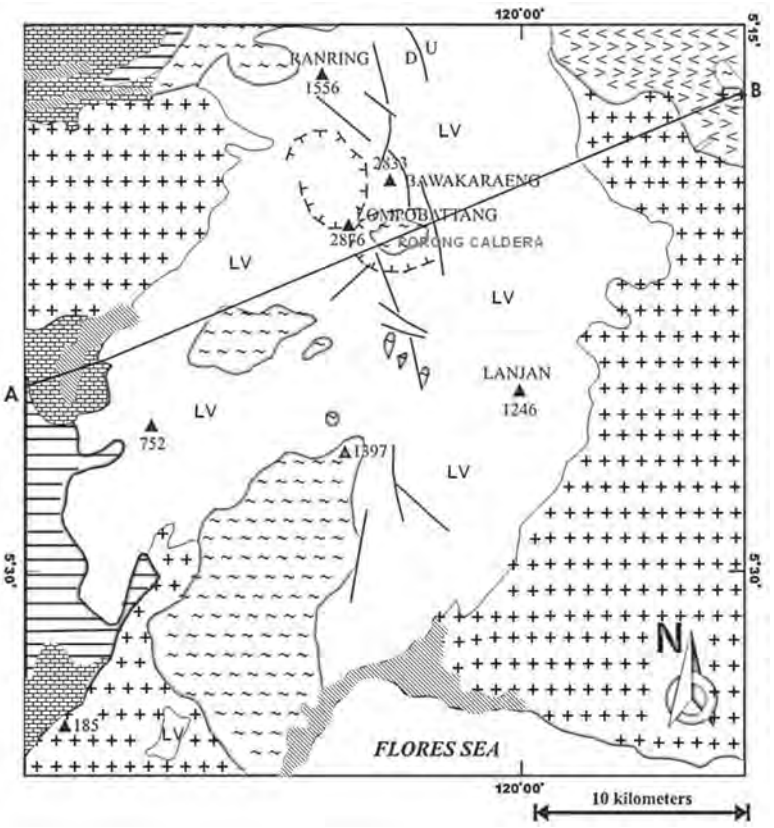


Fig. 2B

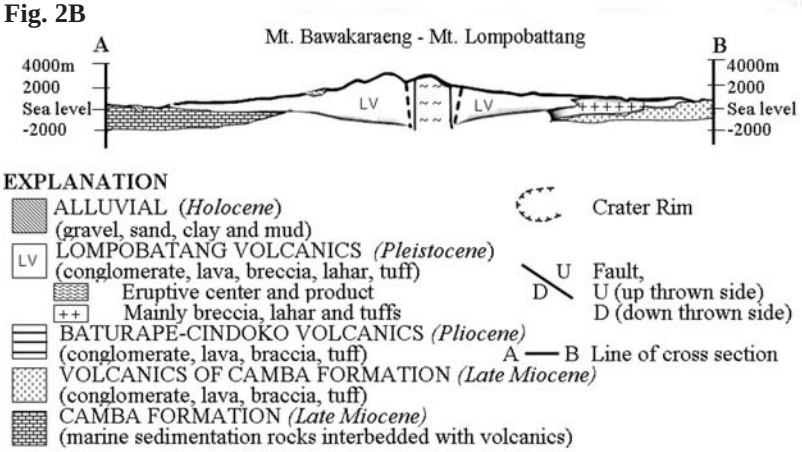


Fig. 2: Geological map (2A) and cross-section (2B) of Mt. Bawakaraeng Caldera and its vicinity (modified from Sukamto and Supriatna 1982)

by high relief, extreme slope, high degree of weathering as well as erosion activities such as soil movement and landslides (Sukamto and Supriatna 1982). A short description of basement rocks around Mt. Bawakaraeng is given below.

The Tonasa Formation: It consists of limestone and marl of Eocene to Middle Miocene epochs. The limestone is gently folded with dip of beds less than 25°.

The Camba Formation: It consists of tuffaceous sandstone, tuff, mudstone, and pyroclastic rocks of Late Miocene epoch. It is widely distributed from the Maros district to Jeneponto district, and forms mountainous and hilly areas in the middle reaches of the Jeneberang River.

The Baturape-Cindako Volcanic Rocks: They were formed by volcanic activity in Pliocene epoch, containing tuff and lava accompanied by conglomerate and breccia. They are distributed in the vicinity of Mt. Maja in southern part of Gowa and in the vicinity of the right tributary of the Jeneberang River.

Intrusive rocks: Basalts, andesites, and diorites of Late Miocene to Pliocene epochs are distributed as dikes, sills and stocks. They are intruded as a small rock bodies into sedimentary and volcanic rocks and distributed from the Maros district to Jeneponto district.

Lompobattang Volcanics: They consist of andesitic volcanic rocks of Pleistocene epoch with lava, pyroclastic rocks, and secondary deposits. Vent comprises effusive rocks at the central portion of Porong Caldera. The volcanic rocks are distributed around eastern portion of the Gowa district and form the mountain area in the headwaters of the Jeneberang River.

GULLY EROSION ON DEPOSITED SEDIMENT

In March 2004, a large landslide with debris flow deposited a few hundred million cubic metres of sediments in Mt. Bawakaraeng Caldera. Subsequently rainfall developed gullies of about 25 m to 100 depth on these newly deposited sediments. Fig. 3 shows gully erosion on deposited sediments in Mt. Bawakaraeng Caldera. Profiles and an estimated volume of deposited sediments in the lower reaches close to settlement area are shown in Fig. 4 and Table 1 respectively. The estimated volume of deposited sediments close to the settlement area was about 15 million m^3.

CAUSES AND EFFECTS

Pyroclastic rocks such as breccias and tuffs around the vent are soft with low strength and they are prone to erosion. Sedimentary rocks trapped in volcanic rocks have a low degree of cementation due to lava and pyroclastic flows and may create chances of slip. This accounts for the body collapse of mountain walls and erosion after Lompobattang volcanic

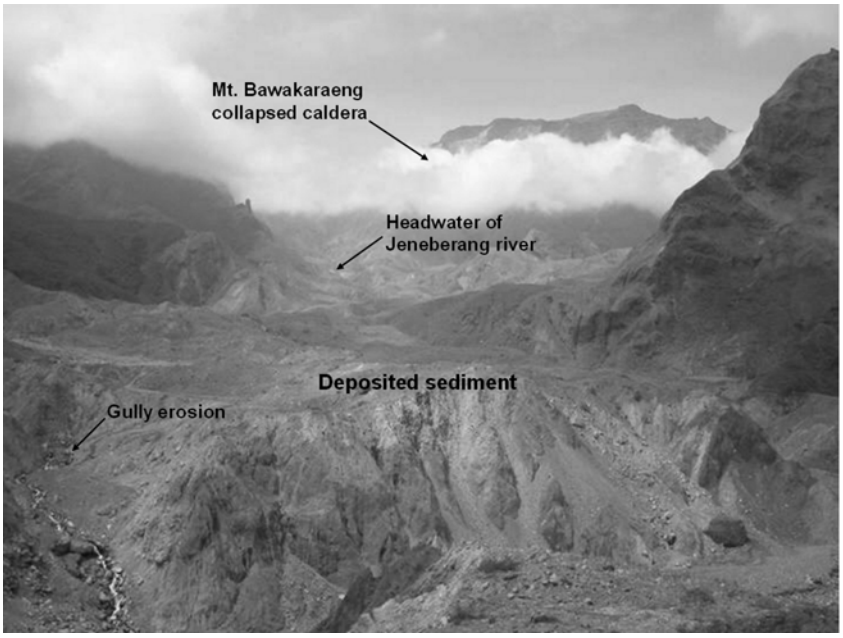


Fig. 3: Gully erosion on deposited sediments close to settlement area (Hasnawir et al. 2006)

Fig. 4A

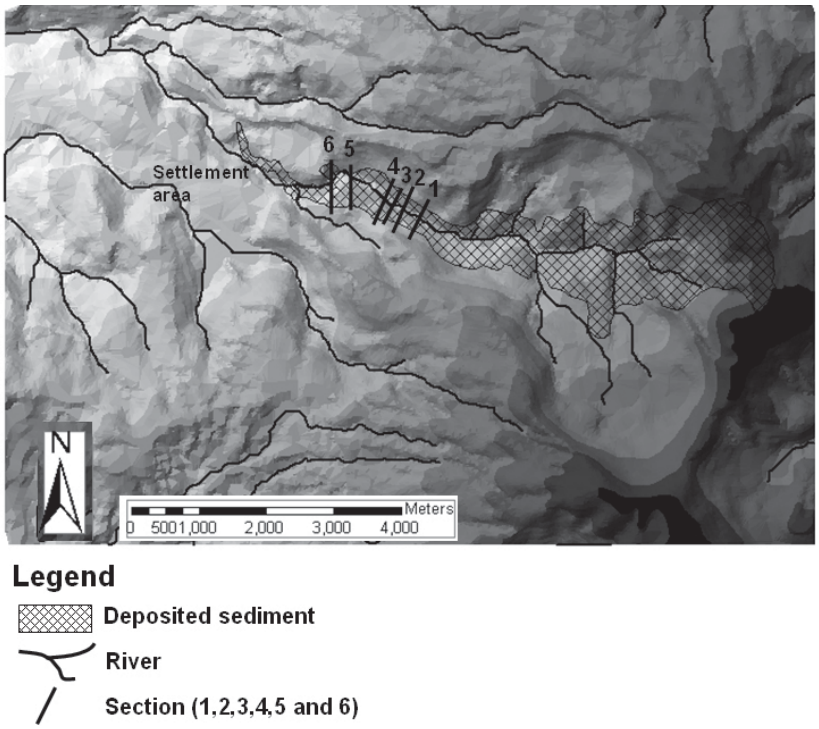


Fig. 4B

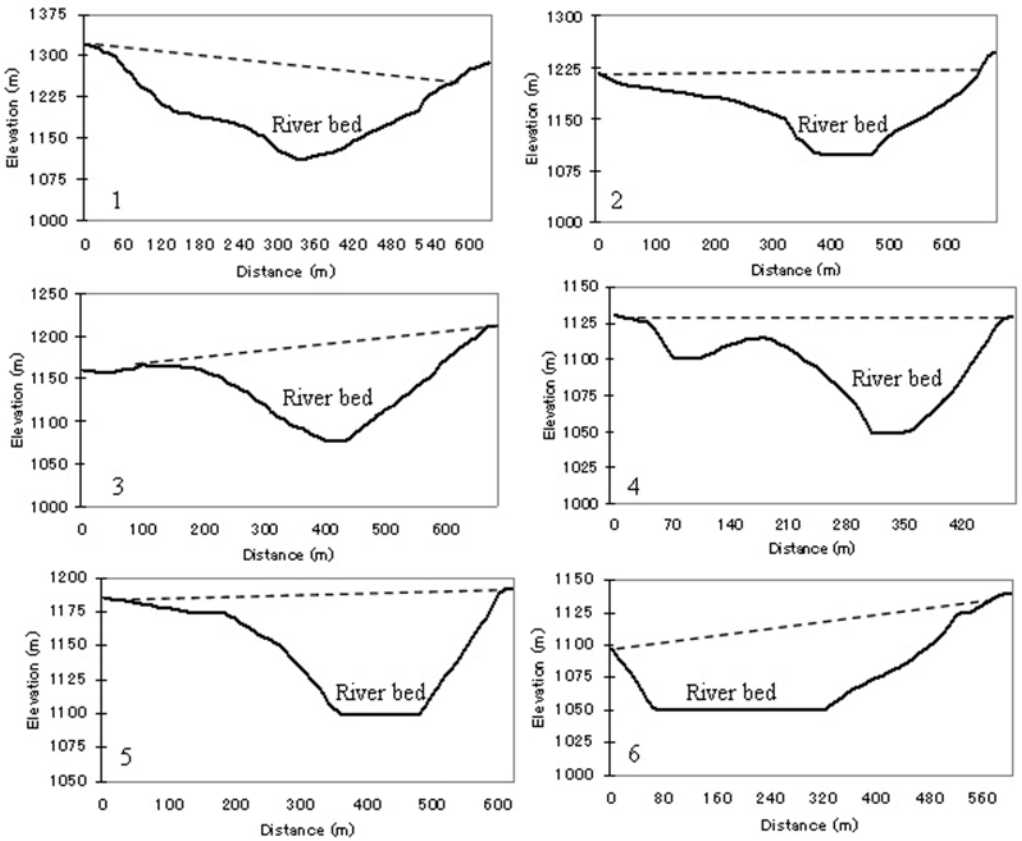


Fig. 4: Map (4A) and profiles (4B) of the deposited sediments. The estimated volume of deposited sediments close to settlement area is about 15 million m^3

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Tokuoka, T. and Yoshida, M., 1984, Some characteristics of Siwalik (Churia) Group in Chitwan Dun, Central Nepal. Jour. Nepal Geol. Soc., v. 4, (Sp. Issue), pp. 26–55.

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Table 1: Estimated volume of deposited sediments close to settlement area

No	Elevation (m)	Area A (m^2)	Depth Mean, D (m)	Volume V=A*D (m^3)	Location
1	1,241	0			05°18'15" S latitude and 119°53'29" E longitude
2	1,199	150,000	40	6,000,000	05°18'23" S latitude and 119°53'23" E longitude
3	1,241	40,000	50	2,000,000	05°18'02" S latitude and 119°53'25" E longitude
4	1,241	45,000	38	1,710,000	05°18'02" S latitude and 119°53'20" E longitude
5	1,241	120,000	38	4,560,000	05°17'56" S latitude and 119°53'11" E longitude
6	1,241	112,500	25	2,812,000	05°17'55" S latitude and 119°52'59" E longitude

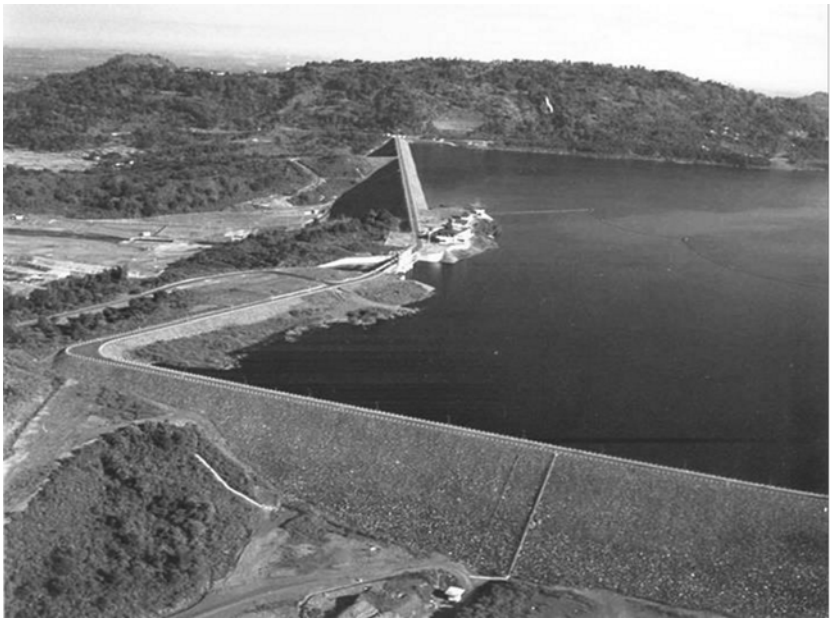


Fig. 5: Bili-Bili Multipurpose Dam (Source: Ministry of Public Works 2000)

activity. As a result, a huge pile of sediments flows continuously downstream to disturb the natural environment and ecosystem as well as the dam.

There are various factors affecting slope stability and some of them are closely related. The majority of landslides and debris flows in Mt. Bawakaraeng Caldera have been triggered by intense rainfall. Annual rainfall in the study area is about 4000 mm. In the study area, the rainy season lasts from November to March. The total rainfall from 1 to 26 March 2004 was 782 mm with a maximum intensity of 70 mm/hr, triggering the landslide on 26 March 2004.

Since March 2004, the headwater of the Jeneberang River has been covered by sediments due to landsliding. There is tremendous suspended sediment load in the river water. During the dry season, the sediment does not disturb the river flow a lot. However, during the rainy season, the sediments in the Jeneberang River reach the entrances of the Bili-Bili Dam and the water treatment plant of Somba Opu. The Somba Opu company belongs to the local government (PDAM), which supplies water from the Jeneberang River to the municipalities of Gowa and Makassar districts.It was the worst disaster ever happened in the history of the drinking water company in Makassar. In January 2005, the company stopped the water supply for 10 days and 350,000 people suffered with the shortage of water. In addition, the fish habitat of the Jeneberang River was damaged (Ministry of Public Works 2005). In general, the river ecosystem was destroyed and the intense sedimentation reduced the lifetime and function of the Bili-Bili Dam (Fig. 5). The suspended load and turbidity condition in the Bili-Bili Reservoir between September 2004 and March 2005 is shown in Fig. 6.

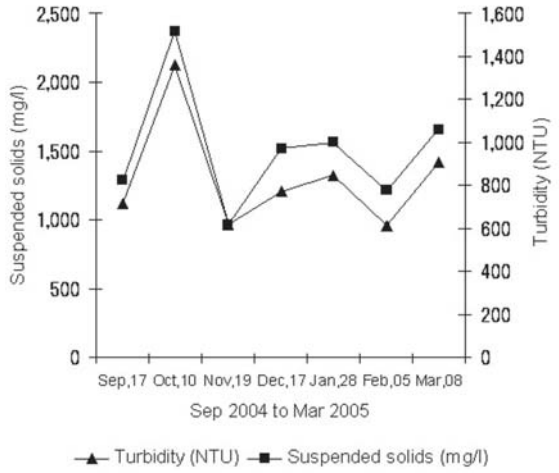


Fig. 6: Suspended and turbidity condition of Bili-Bili Dam Reservoir from September 2004 to March 2005

On the other hand, the landslide occurred in Mt. Bawakaraeng has also brought some positive impacts such as sand mining, which has increased the income of the local people. It can be noted that the local price of a cubic metre of sand is US$ 9 and ten private companies are involved in sand mining (Fig. 7).

CONCLUSIONS AND RECOMMENDATIONS

a. Mt. Bawakaraeng Caldera in the upper Jeneberang Watershed constitutes weak and low-strength rocks such as pyroclastic rocks and loosely cemented sedimentary rocks that lead to mountain body collapses. Due to this, it affects the mountain environment and ecosystem as well as the dam on the Jeneberang River.

b. The majority of landslides and debris flows have been triggered by intense rainfall.

c. Sediment-related disaster mitigation should be implemented in integrated and comprehensive manner with the development of the region and always in harmony to balance with the natural environment for a better prosperity.

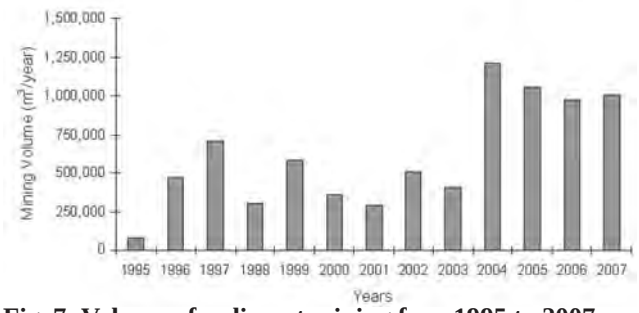


Fig. 7: Volume of sediment mining from1995 to 2007 (Source: Ministry of Public Works 2007)

d. A regional management process is necessary to implement sustainable sand mining practices, which can improve the economy of the residents.

ACKNOWLEDGEMENT

We would like thank Kyushu University Interdisciplinary Programmes in Education and Projects in Research Development (P & P) for financial support to carry out the fieldwork.

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हिस्तान मण्डली गा.वि.स., औल गाउँका वडा नं. ७ र ८ मा गएको पहिरोको अध्ययन

वीरेन्द्र पिया तथा दिनेश नेपाली
खानी तथा भूगर्भ विभाग, काठमाडौँ, नेपाल

परिचय

औल गाउँ म्याग्दी जिल्लाको हिस्तान मण्डली गा.वि.स. को वडा नं. ७ र ८ मा पर्ने एउटा सुन्दर बस्ती हो (चित्र १) । यो गाउँ समुद्रको सतहदेखि करिब १५५० मिटरको उँचाइमा अवस्थित छ। यो गाउँको पूर्व तिरबाट पूर्व–पश्चिम भई औला खोला बगेको छ। यस गाउँका चारैतिर अग्लाअग्ला भिराइला पहाडहरू छन् । यस गाउँमा हाल करिब १४३ घर धुरी छन् र करिब ८०० जनाको जनसंख्या छ (साभार : कान्तिपुर दैनिक, मिति २०६४ असार ४ गते) । स्थानीय व्यक्तिहरूको भनाई अनुसार वि.सं. १७९२ तिर यहाँका वासिन्दाहरू नजिकका पहिरो गाउँबाट बसाईं सरी यहाँ बसोवास गर्दै आएका हुन् । यहाँ पुन थर भएका मगर जातिहरूको अत्यधिक बसोवास छ । यस क्षेत्रका वासिन्दाहरूको मुख्य पेशा खेती तथा पशुपालन नै हो। यहाँ समशितोष्ण प्रकार (Temperate type) को हावापानी पाइन्छ। गाउँदेखि पूर्व र दक्षिण भागमा खेतीयोग्य जमिन रहेको छ, जसमा धान, मकै, कोदो तथा विभिन्न प्रकारका तरकारीहरू मौसम अनुसार उत्पादन गरिन्छन् ।

उद्देश्य

यस अध्ययनका मुख्य उद्देश्य निम्न बमोजिम थिए :

(क) औल गाउँ तथा विशाल चट्टान रहेको स्थान वरिपरिको भौगर्भिक अध्ययन गर्ने ।

(ख) गाउँदेखि माथि करिब ७०० मिटरको उँचाइमा रहेको विशाल चट्टानलाई विष्फोटक पदार्थ प्रयोग गरी फुटाएको खण्डमा पर्न सक्ने नकारात्मक असरको अध्ययन तथा अनुसन्धान गर्ने ।

(ग) त्यस ठाउँमा पहिरो जानुको कारण पत्ता लगाउने ।

(घ) पहिरोको रोकथाम तथा खस्नसक्ने चट्टानका टुक्राहरूबाट गाउँबस्ती बचाउन सक्ने सुरक्षाका उपायहरू बारे अध्ययन गरी उपयुक्त सुझाव पेश गर्ने ।

वर्तमान स्थिति

म्याग्दी जिल्ला हिस्तान मण्डली गा.वि.स. वडा नं. ७ र ८ मा पर्ने औल गाउँदेखि करिब ७०० मिटरको उँचाइमा एउटा (३० मि. x २० मि. x १६ मि.) अर्थात ९,६०० घन मिटर आकारको विशाल चट्टान आफ्नो ठाउँबाट छुट्टिएर झर्न सक्ने अवस्थामा रहेको छ। उक्त विशाल चट्टानसँगै पश्चिमपट्टि एउटा पहिरो छ, जुन स्थानीय वासिन्दाहरूको भनाई अनुसार २०६३ साल भाद्र महीनाको दोश्रो हप्तामा गएको थियो । उक्त पहिराले गाउँलाई कुनै क्षति नपुऱ्याए पनि त्यसको केही दिनमा (भाद्र १५ गते) २.९० मि. x १.७५ मि. x १.३० मि. अर्थात् ६.६ घन मिटरको एउटा चट्टानको टुक्रा उक्त गाउँ नजिक खसेको थियो। भाग्यवश, उक्त चट्टानले पनि गाउँलाई कुनै क्षति पुऱ्याएन । हाल पनि उक्त स्थानमा पहिरोका कारण विकसित भएका असंख्य चिराहरू तथा पानीको



चित्र १ : हिस्तान मण्डली गा.वि.स., औल गाउँको दृश्य

प्रक्रियाबाट क्षयीकरण भइरहेका चट्टानका टुक्राहरू कुनै पनि बेला छुट्टिई तल गाउँमा खस्नसक्ने सम्भावना रहेको छ। मुख्यतया भारी वर्षा भएको समयमा अथवा भूकम्प गएको समयमा उक्त स्थानमा अस्थीर रुपमा रहेका चट्टानहरू खसी गाउँमा धनजनको क्षति हुने सक्ने बढी सम्भावना रहेको छ।

हाल पहिरोको दुवैतिर दायाँ तथा बायाँ साइडका चट्टानहरूमा चिराहरू (Cracks and fissures) परी अस्थीर अवस्थामा रहेका छन्। वर्षायाममा पानीको भल पहिरोको बाटो भई बग्ने हुँदा यसले Debris flow को रुप पनि लिनसक्ने सम्भावना छ। विशाल चट्टानको माथिल्लो तहमा रहेको Quartzite को २ देखि ३ मिटर सम्मका मोटाई भएका चट्टानका तीन चिरा भई उक्त ठाउँमा अडि बसेका छन्। विशाल चट्टान रहेको भित्तापट्टि उक्त चट्टान तलतिर खस्किरहेका चिन्हहरू (Vertical displacement marks) देख्न सकिन्छ। गाउँलेको अनुसार १ वर्ष भित्रमा उक्त चट्टान करिब ५६ से.मि. जति तल (Vertically) खस्किसकेको छ। त्यस्तैगरी उक्त चट्टान ज्यचष्टायलतर्बाथि १५ से.मि. जति सरि सकेको छ। यसले उक्त स्थान भौगर्भिक हिसाबले अस्थीर अवस्थामा रहेको देखाउँदछ।

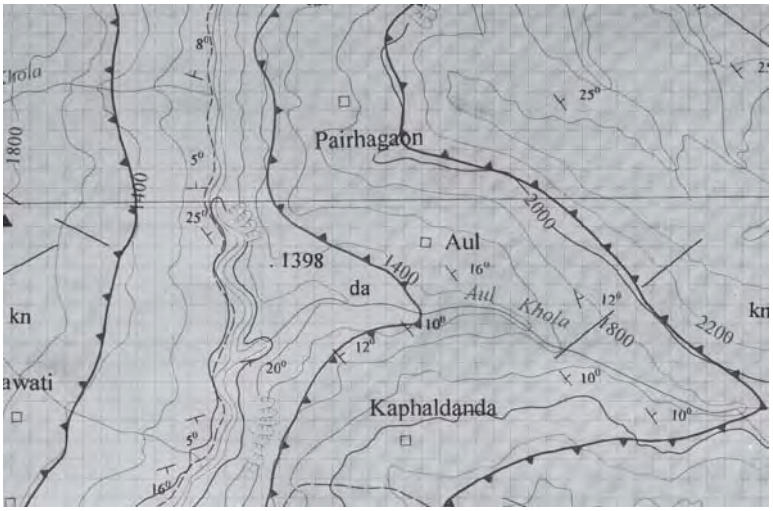
हाल उक्त स्थानमा स्थानीय वासिन्दाहरूले खस्नसक्ने चट्टानहरूबाट गाउँलाई बचाउनका लागि विभिन्न संघ-संस्थाहरूको सहयोगमा ४५ मिटर लामो तथा १ मिटर चौडा र २ मिटर अग्लो पक्की ग्याबियन पर्खाल बनाएका छन्। त्यस ग्याबियन पर्खालको चट्टानतिर करिब ३० मिटर दुरीमा अर्को अस्थाई ग्याबियन पर्खाल (Gabion wall) पनि बनाएको छ। यसरी बनाएको ग्याबियन पर्खालले पनि टुक्री झरेका चट्टानहरूलाई रोक्न मद्दत पुऱ्याउँदछ। त्यस्तैगरी, चट्टानभन्दा माथितिर को Slope मा वर्षाको पानी पहिरोतिर आउनबाट बचाउन दुवै दिशातिर (देब्रे र दाहिने) पानी जाने कुलेसँहरूको निर्माण गरिएको छ। यसरी प्रकोपबाट गाउँलाई धनजनको क्षतिहुनबाट बचाउन स्थानीय वासिन्दाहरूले आँनो प्रयास जारी राखेका छन्।

स्थानिय वासिन्दाहरूको चाहना सम्भव भएसम्म उक्त चट्टानलाई विष्फोटन गरी फुटाउने रहेको छ। यस कार्यको लागि म्याग्दी जिल्ला स्थित नेपाली सेनाले जिल्ला प्रशासनको अनुरोधमा, स्थानीय वासिन्दाहरू तथा सम्वन्धित विज्ञहरूको समेत सहमति प्राप्त भएमा उक्त कार्य सम्पन्न गर्ने आश्वासन दिएको स्थानीय वासिन्दाहरू बताउँदछन्। हाल स्थानीय वासिन्दाहरू पानी परेका बेला माथिको उक्त ठूलो तथा अन्य चट्टानहरू खसी जिउधनको नोक्सान पुऱ्याउनसक्ने डरले गाउँदेखि केही पर रहेका खेतबारीहरूमा अस्थाई रुपमा गोठ, टहरा बनाई बस्नेगरेका छन्।

भौगर्भिक अवस्था

औल गाउँ भौगर्भिक हिसाबले महाभारत पर्वत क्षेत्र (Lesser Himalayan Zone) मा पर्दछ। खानी तथा भूभर्ग विभागबाट प्रकाशित भौगर्भिक नक्शा Toposheet No. 2883 11 (62 P/11), 2002 अनुसार यो क्षेत्र Kuncha Formation मा पर्दछ। यस Formation का चट्टानहरू light greenish grey to dark grey sericitic, chloritic phyllite र yellowish green gritty phylite interbedded with several quartzite ले बनेका छन्।

सम्वन्धित ठाउँमा गरेको भौगर्भिक अध्ययन अनुसार यस ठाउँका चट्टानहरू (Phyllites) धेरै नै मक्किएका (highly weathered) छन् भने quartzite चट्टानहरू मा चिरा परेका (jointed) छन्।



चित्र २ : औल क्षेत्रको भौगर्भिक नक्शा (खा.त.भू.वि. सन् २००२)

उक्त स्थानका विभिन्न ठाउँमा गरेको भौगर्भिक नाप (Geological measurement)

उक्त स्थानका चट्टानहरूको attitude: strike N12°W, dip direction 78°NE तथा dip amount 10° देखि 15° (variation) रहेको छ । खानी तथा भूभर्ग विभागबाट प्रकाशित यस क्षेत्रको जियोलोजिकल नक्शा अनुसार यो ठाउँ भएर एउटा Thrust गएको छ (चित्र २) भने उक्त क्षेत्रमा विशाल चट्टानको केही पर एउटा Normal fault पनि देखिएको छ (चित्र ३) । यही fault line भएर उक्त विशाल चट्टान आफ्नो ठाउँबाट छुट्टिई dip direction सँग perpendicular भई slope direction तिर सरिरहेको देखिन्छ र यो प्रक्रिया निरन्तर चलिरहेको छ । यस्तो किसिमको भौगर्भिक प्रक्रियाका कारणले गर्दा उक्त स्थान स्थीर नभएको देखिन्छ ।

GPS बाट लिइएको पहिरो गएको स्थानको Location:

Northing (अक्षांश)	-	28°25.17’
Easting (देशान्तर)	-	83° 37.028’
Slope direction:		Towards south

उक्त क्षेत्रमा पहिरो जानु तथा जमिन अस्थिर रहनुका कारणहरू

भौगर्भिक स्थिति तथा भिरालो जमिन

भौगर्भिक हिसाबले उक्त स्थान निकै भिराइलो जमिनमा अवस्थित छ । त्यस ठाउँको भिराइलो सतहको slope झण्डै ५०° देखि लिएर ८५° सम्मको छ । यस्तो भिराइलो जमिनमा ढुङ्गा-माटो अडिइरहन सक्दैन र कुनै वाह्य वल (जस्तै भूकम्प तथा वर्षाको पानी) को चाप बढ्न गएमा पहिरो जाने तथा Rock fall हुने सम्भावना बढिरहन्छ । फेरि उक्त ठाउँमा क्षयीकरण भइरहेका कमजोर चट्टानहरू (Weathered Phyllite) रहेका छन् । त्यस्तैगरी उक्त स्थानमा रहेका चट्टानहरूमा असंख्य रुपमा चिराहरू (Cracks or Fractures) विकसित भएका छन् । यसले गर्दा उक्त स्थानमा पहिरो गएको हो र पछि पनि जाने सम्भावना बढी देखिन्छ । त्यस्तैगरी उक्त स्थानमा कमजोर भौगर्भिक संरचनाहरू (Fault तथा Joint हरू) रहेको देखिन्छ । यसले गर्दा पनि उक्त स्थानलाई बढी अस्थिर बनाएको छ ।

अत्यधिक वर्षा

नेपालमा धेरै पानी पर्ने जिल्ला मध्ये म्याग्दी जिल्ला पनि एक हो । वर्षाको पानी भिराइलो जमिन भई बग्ने हँदा यसले पहिरो जानलाई मद्दत पुऱ्याउँदछ । अत्यधिक वर्षाको कारण पानी जमिन भित्र पस्नगई जमिनको भार बढ्न जान्छ र उक्त भारलाई जमिनको सतहले थाम्न सक्दैन, त्यसैगरी पानीको चापले गर्दा ढुङ्गामाटो आफ्नो स्थानमा अडिन सक्दैन र तलतिर खस्किनगई पहिरोको रुप लिन्छ । यही कारणले गर्दा उक्त स्थानमा पहिरो गएको हो ।

निष्कर्ष

औल गाउँ माथि करिब ७०० मिटरको उँचाईमा अस्थीर अवस्थामा रहेको विशाल चट्टानलाई विष्फोटक पदार्थ प्रयोगगरी तह लगाउने र गाउँलाई सुरक्षित पार्ने स्थानीय वासिन्दाहरूको मनसाय भएता पनि त्यस ठाउँको भौगर्भिक जटिलताका कारण ठूलो खालको विष्फोटक पदार्थ प्रयोग गरी चट्टान फुटाउन उपयुक्त नहुने देखिन्छ । किनभने विष्फोटकको प्रयोगबाट उत्पन्न हुने कम्पन तथा अत्यधिक आवाजले पनि वरिपरीका चट्टानहरूलाई दखल दिनसक्ने र virgin condition मा स्थीर भई रहेका चट्टानहरूलाई समेत कमजोर गर्न सक्ने र साथै कमजोर अवस्थामा रहेका चट्टानहरूलाई पहिरोमा बदल्न सक्ने हुनसक्छ । तसर्थ विष्फोटक पर्दाथका वैकल्पिक उपायहरू अपनाउनु उपयुक्त देखिन्छ ।



चित्र ३ : पहिरोदेखि तल गाउँसम्मको विहङ्गम दृश्य

औल गाउँ माथि रहेको उक्त चट्टान तथा अन्य वरिपरि कमजोर अवस्थामा रहेका चट्टानहरूबाट गाउँ असुरक्षित रहेको देखिन्छ र त्यसलाई जतिसक्दो चाँडो न्यूनीकरणका उपायहरू अवलम्वन गरी गाउँलाई पहिरोबाट बचाउन आवश्यक देखिन्छ ।

उक्त स्थान भौगर्भिक हिसाबले निकै जटिल अवस्थामा रहेको छ ।

यस स्थानको भौगर्भिक जटिलताले गर्दा स्थाई रुपमा यो समस्यालाई समाधान गर्न नसकिएता पनि अस्थाई रुपमा यो क्षेत्रको समस्याको हल गर्नसकिने अवस्था देखिन्छ । यस कार्यका लागि तल दिईएअनुसारका न्यूनीकरणका उपायहरू अवलम्वन गर्नु जरुरी छ ।

समस्या समाधानका उपाय

औल गाउँमा भविष्यमा जान सक्ने पहिरो, खस्न सक्ने चट्टान तथा चट्टानमा देखापरेका चिराहरूलाई विचार गरी स्थाई रुपमा रोकथाम गर्न भौगर्भिक स्थिति तथा भिराइलो जमिन भएका कारण कम सम्भव देखिएता पनि यसको असरबाट जन-धनको क्षति रोक्न वा कम गर्न निम्न अनुसार का रोकथामका उपायहरू अपनाउनु अत्यावश्यक देखिन्छ ।

तत्कालीन उपाय (Immediate solution)

नजिकिँदै गएको वर्षायाम (Monsoon season) लाई मद्देनजर गरी गाउँलाई कुनै पनि प्रकारको Rock fall तथा Debris flow बाट बचाउन निम्न अनुसारका उपाय तत्कालीन रुपमा अवलम्वन गर्नु उचित हुने देखिन्छ ।

१ पहिरोको दायाँ तथा बायाँ छेउतिर अस्थीर अवस्थामा रहेका चट्टानहरूलाई जतिसक्दो चाँडो त्यहाँबाट निकाली तल नखस्ने गरी व्यवस्थापन गर्नुपर्ने देखिन्छ ।

२ पहिरोदेखि माथिको भागमा पहिरोसम्म वर्षाको पानी आउनबाट रोक्न बनाईएका Drainage path लाई सिमेन्टको प्रयोग गरेर नचुहिने र नरसाउने गरी व्यवस्थित गर्ने ताकि वर्षाको पानी भलको रुपमा पहिरोसम्म बगी नजाओस् । साथै पहिरोबाट भल भई झर्ने पानीको पनि आवश्यक व्यवस्था मिलाउनु पर्दछ ।

३ Gabion पर्खालहरू बनाउँदा त्यसमा प्रयोग भएका ढुँहरूको तौलले गर्दा जमिनमा भार थपिन जाने भएको हुँदा बलियो जमिन (जग) नभएको ठाउँमा यसको बदलामा अन्य भार कम हुने खालका, जस्तै : बाँसका बारहरूको प्रयोग गरी Fence बनाउने । यस्ता बाँसहरूबाट बनाउने Fence केही मिटरको दुरीमा तह तहगत रुपमा राख्दा अझ राम्रो हुनसक्छ ।

४ गाउँ भन्दा माथि कम्तिमा पनि ५० मिटरको दुरीसम्म तार-जालीका बारहरू लगाउने ।

५ Unstable अवस्थामा रहेका विशाल ढुङ्गाहरू फुटाउनको लागि ढुङ्गामा बनेका चिराहरू (Fractures) तथा Crack हरूमा तापको प्रयोग गरेर Expansion and contraction प्रक्रियाबाट ढुङ्गा फुटाउन सकिन्छ । साथै Jack hammering र Wedging बाट पनि ढुङ्गालाई फुटाउन सकिन्छ ।

६ वर्षाको पानीको कारण उक्त स्थानमा पर्न सक्ने असर (Landslide, debris flow, rock fall) बारे अग्रिम जानकारी पाउनको लागि उक्त स्थानमा विकसित हुँदै गरेका अवस्थाहरूको नियमित अनुगमन (Monitoring) गर्ने व्यबस्था मिलाउने ।

दीर्घकालीन उपाय (Long-term solution)

१ उक्त स्थानमा देखापरेको जटिल समस्यालाई दीर्घकालीन रुपमा हल गर्न विभिन्न विषयसँग सम्वन्धित विशेषज्ञहरूको संयुक्त टोली (Geologist, Geotechnical engineer, Civil engineer) बाट विस्तृत अध्ययन (Detail study) गराउनुपर्ने देखिन्छ ।

२ अस्थीर अवस्थामा रहेका चट्टानहरूलाई फुटाई आवश्यकता अनुसार Retaining wall हरूको निर्माण गर्नु पर्ने जसलेगर्दा माथिबाट खस्ने ढुङ्गा, माटो तथा पहिरो रोक्न सकियोस् ।

३ वर्षाको पानीको भलबाट उक्त क्षेत्रलाई बचाउन वैज्ञानिक प्रकारको Drainage system बनाई पानीको व्यवस्थापन गर्नुपर्ने ।

४ Bio-engineering technique अपनाई औल गाउँ माथि तथा पहिरो भएको ठाउँ वरिपरि व्यापक रुपमा सुहाउँदो प्रकारको बृक्षारोपण गर्नुपर्ने ।

५ चिरा (Fracture) परेको ठाउँमा वर्षाको पानी पस्नबाट रोक्न चिरा परेको ठाउँमा Cement grouting गर्ने । Load कम गर्ने तथा slope stable गराउन stepping cutting गर्ने ।

६ त्यहां रहेको विशाल चट्टान तथा वरिपरीका ढुङ्गालाई फुटाई निस्केका ढुङ्गाका टुक्राहरूलाई अन्यत्र ठाउँमा व्यवस्थापन गर्नुपर्ने ।

७ उक्त स्थानमा अस्थीर अवस्थामा रहेका चट्टानको vertical / horizontal चाल (Movement) थाहा पाउनका लागि नियमित रुपमा अनुगमन (Monitoring) गर्नुपर्ने ।

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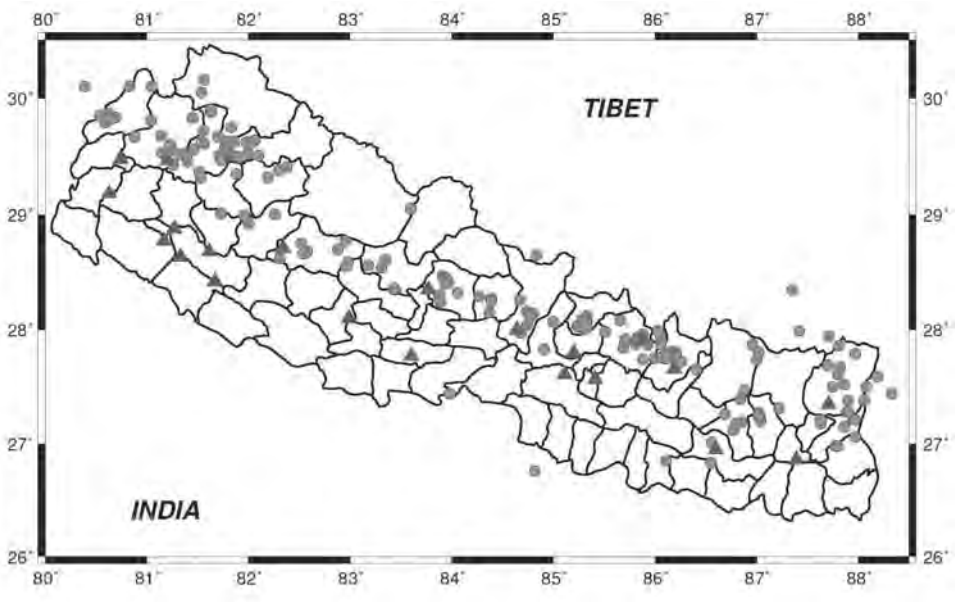
भूकम्पको भविष्यवाणि तथा सम्भावना

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परिचय

पृथ्वीमा दिनहुँ सयौँको संख्यामा भूकम्पहरू गइराखेका हुन्छन्, जसमध्ये धेरैजसो साना हुन्छन् । तर ती मध्ये सानो संख्यामा रहेका, केही भूकम्प निकै शक्तिशाली हुन्छन् जस्ले ठूलो मानवीय तथा भौतिक क्षति पुऱ्याउँछन् र उक्त देशको आर्थिक अवस्थामै नराम्रो असर पार्न सक्छन् । ठूला भूकम्पको केन्द्रबिन्दू मानवबस्तीको नजिक परेमा तथा भूकम्प रातको समयमा गएमा स्थिति कहालीलाग्दो हुनसक्छ । ठूला भूकम्पले केही सेकेन्डमै हजारौँको ज्यान लिन्छन, लाखौँलाई घाइते र घरबार बिहीन बनाइदिन्छन जस्को पीडा जीवनभर मानसपटलमा बसिरहन्छ। भूकम्पबाट अचानक ठूलो जन-धनको क्षति हुने गरेकाले भूकम्पको भविष्यवाणिको चारैतिरबाट आवाज उठिरहेको छ । यस्तो जनअपेक्षा भूकम्पको क्षेत्रमा काम गरिरहेका वैज्ञानिकहरूको लागि एक ठूलो चुनौतीका साथै प्रेरणा पनि बनेर उभिएको छ ।

भूकम्पहरू विश्वभर तर केही निश्चित स्थानहरूमा दैनिक जाने गर्दछन् । यस्ता निश्चित स्थानहरू टेक्टोनिक प्लेटका सिमानाहरूमा पर्दछन् । हिमालय क्षेत्र यस्तै एक सिमानामा पर्दछ जस्ले भारतीय प्लेट र यूरेशियन प्लेटलाई छुट्याउँछ । नेपालमा पनि वर्तमानमा भूकम्पहरू गइराखेका छन् तर धेरैजसो साना छन् र यन्त्रको माध्यमबाट मात्र यस्ता भूकम्पहरू थाहा पाइन्छन् । साधारण अवस्थामा, भूकम्पको म्याग्निच्यूड करिब चार वा सो भन्दा माथिको भएमा मात्र हामीले यसको अनुभव गर्न सक्दछौँ (चित्र १) । लिखित इतिहासमा, विशेष गरेर नेपालको पूर्वी भागमा ठूला भूकम्पहरू गएर ठूलो जन-धनको क्षति भएका प्रमाणहरू भेटिएका छन् । वि. सं. १९९० मा, भोजपुरमा केन्द्रबिन्दु भएको (म्याग्निच्यूड ८.२), महाभूकम्प तथा वि. सं. २०४५ मा उदयपुरमा केन्द्रबिन्दु रहेको (म्याग्नेच्यूड ६.५) भूकम्पहरू नेपालमा गएका ठूला भूकम्पका पछिल्ला उदाहरणहरू हुन् । नेपाल लगायत यसका सीमा



चित्र १: सन् १९९३ देखि २००७ सम्म नेपाल तथा यसका आसपासमा गएका म्याग्निच्यूड चार वा सो भन्दा ठूला भूकम्पहरू (वृत्त) तथा भूकम्प सम्वेदन केन्द्रहरू (त्रिभुज) । स्रोत : खानी तथा भूगर्भ विभाग, राष्ट्रिय भूकम्प मापन केन्द्र

क्षेत्रमा निरन्तर रुपमा बढ्दो जनसंख्या, अनियन्त्रित एवं अव्यवस्थित रुपमा बढ्दो शहरीकरण र कमजोर निर्माण कार्यहरूका कारणले वि. सं. १९९० को जत्रो भूकम्प अहिले गएमा निकै ठूलो संख्यामा मानिस हताहत हुने अनुमान सहजै गर्न सकिन्छ। भूकम्पबाट हुने क्षतिमा स्थान विशेषको भौगर्भिक बनावटको पनि भूमिका हुन्छ । कमलो भौगर्भिक बनावट भएका स्थानहरूमा भूकम्पका तरङ्गहरूको एम्प्लिच्यूड बढ्ने भएकाले काठमाडौँ उपत्यका र तराईजस्ता स्थानहरूमा भूकम्पले बढी क्षति पुऱ्याउन सक्छ। भौगर्भिक बनावट बाहेक मानिसको बाक्लो बस्ती, भूकम्पको स्रोत क्षेत्रबाट मानवबस्ती बीचको दूरी, भूकम्पको म्याग्निच्यूड, भूकम्पको कम्पन अवधि, भूकम्प गएको समय (किनभने रातको समयमा भूकम्प गएमा बढि क्षति हुन सक्छ) र मानवनिर्मित कमजोर संरचना (घर) ले पनि भूकम्पको असर व्यापक पार्न सहयोग गर्दछन् ।

भूकम्पको भविष्यवाणि

भूकम्पको भविष्यवाणिका लागि विश्वमा निकै प्रयासहरू भएका छन् र भइरहेका छन् तर अहिलेसम्म भरपर्दो प्रविधि हातलागेको छैन । ठूला ऐतिहासिक भूकम्पको राम्रो अध्ययन भएका क्षेत्रहरूमा भविष्यमा ठूलो भूकम्प जाने सम्भावना भएको स्थानको अनुमान गर्न सम्भव छ तर भूकम्प जाने समयको बारेमा भने केही पनि अनुमान गर्न सकिँदैन । भूकम्पको भविष्यवाणि गरेर जन-धनको क्षति कम गर्न भूकम्पबाट बढी प्रभावित हुने जापान, अमेरिका, चीन तथा तत्कालीन सोभियत संघले यस क्षेत्रमा निकै ठूला प्रयासहरू गरेका छन् र गरिरहेका छन् । ठूला भूकम्प गएका क्षेत्रहरूमा भूकम्प जानु अघि geophysical, geochemical तथा geodetic गुणहरूमा परिवर्तनहरू आउने गरेका विभिन्न रिपोर्टहरू सङ्कलित छन्। विभिन्न देशमा गरिएका अध्ययनहरूबाट, भूकम्प जाने क्षेत्रमा करिब ४०० प्रकारका भूकम्पका सम्भाव्य पूर्वसूचकहरू हालसम्म पाइएका छन् । यस्ता सूचकहरूमा जनावरको अस्वाभाविक व्यवहार पनि पर्दछन् । यस्ता केही पूर्वसूचकहरूको छोटो परिचय तल दिइएको छ ।

जमिनको सतहमा आउने परिवर्तन (Land deformation)

ठूला भूकम्प जाने केही महिना वा दिन अगाडि भूकम्प जाने क्षेत्रमा असामान्य किसिमका परिवर्तनहरू आउने गरेको पाइएको छ । यस्ता परिवर्तनहरूमा सर्भे प्वाइन्टहरू बीचको दूरी, उँचाइ, सतहमा बनेको कोण तथा झुकाव (slope) मा आउने परिवर्तन पर्दछन् ।

जमिनमुनिको जलसतहमा परिवर्तन

भूकम्प जानुपूर्व पृथ्वीको सतहमा आउने परिवर्तनले पृथ्वीको माथिल्लो भाग खुम्चिन जान्छ जस्को कारणले भूभिगत जलभण्डारको सतह बढेर पहिले भन्दा माथी आउन सक्छ। वर्षात्को समयमा यस्तो प्रक्रिया चिन्न नसकिएपनि खडेरीको समयमा अनायास भूभिगत पानीको सतह बढ्ने तथा पानीको मुहानमा बिनाकारण पानीको मात्रा बढ्ने वा घट्ने हुनसक्छ । स्वाभाविक वार्षिक रुपमा हुने भूविस्थापन भन्दा, भूकम्प जानु केही समय अघि, फरक किसिमले छिटो-छिटो भूविस्थापन हुँदा भूभिगत जलभण्डार थिचिनाले भूभिगत पानीको सतह बढद्छ ।

भूकम्पका तरङ्गको गतिमा आउने परिवर्तन

भूकम्पबाट मुख्य दुई किसिमका तरङ्गहरू उत्पन्न हुन्छन् । कुनैपनि स्थानमा प्राइमरी वेभ पहिला आइपुग्छ र त्यसपछि सेकेन्डरी वेभ आइपुग्छ । प्राइमरी वेभको गति तथा सेकेन्डरी वेभको गतिको अनुपात करिब १.७३ छ भने प्राइमरी वेभको गति, पृथ्वीको (माथिल्लो २३ किलोमिटर मोटो भागमा) करिब ५.६ किलोमिटर प्रति सेकेन्ड छ। ठूला भूकम्पहरू जानुपूर्व उक्त दुई किसिमका तरङ्गको गतिको अनुपात घट्ने गरेको पाइएको छ। भूकम्प जानुभन्दा केही समय अघि भूकम्पको स्रोत क्षेत्रमा जमिनमुनि चिराहरूपर्ने (dilatation) कारणले यस्तो परिवर्तन आउनसक्छ ।

भूविद्युतीय गुणमा परिवर्तन

प्रकृतिमा प्रत्येक वस्तुको आफ्नै विद्युतीय गुण हुन्छ । ठूला भूकम्प जानुअघि भूकम्पको स्रोत भएका क्षेत्रमा रहेका चट्टानहरूको विद्युतीय गुणमा पनि परिवर्तन आउने गरेको देखिएको छ । भूकम्प जानुअघि जमिनमुनि अत्यधिक दबावका कारणले चिराहरू तन्कन (dilatation) हुन थाल्दछन् । यसरी बनेका चिराहरूमा पानी वा अन्य तरल पदार्थको प्रवेश हुँदा भूविद्युतीय अवरोध घट्ने गर्दछ र यो गुण भूकम्प गइसकेपछि पुरानै अवस्थामा फर्कने गरेको पाइएको छ ।

पूर्वकम्प (Foreshock) गतिविधि

ठूला भूकम्पहरू जानुभन्दा पहिले केही साना वा मझौला किसिमका भूकम्पहरू जाने गर्दछन् र यस्ता भूकम्पलाई पूर्वकम्प भन्दछन् । यी पूर्वकम्पहरू मानिसले थाहा पाउने वा उपकरणहरूले मात्र थाहा पाउने हुन सक्दछन् । पूर्वकम्पहरू सानोतिनो क्षति पुराउनेखालका हुनसक्छन् जसले हामीलाई अलि सतर्क पनि बनाउँछन् । सन् १९७५ मा चीनको हाइचेंगमा गएको भूकम्पको (म्याग्निच्यूड ७.३) भविष्यवाणि यस्तै प्रकार का केही शक्तिशाली पूर्वकम्पमा पनि आधारित थियो जस्को लगत्तै प्रशासनले शहर खाली गराउने आदेश दिएको थियो । सन १९७६ मा तानसांगमा गएको भूकम्प (म्याग्निच्यूड ७.८) अघि भने यस्ता पूर्वकम्प गएका थिएनन् र भूकम्पको भविष्यवाणि पनि भएको थिएन । सन १८३३ मा काठमाडौँको उत्तरमा केन्द्रबिन्दु रहेको अनुमान गरिएको करिब ७.७ म्याग्निच्यूडको भूकम्पको केही क्षण अगाडि पनि दुई शक्तिशाली पूर्वकम्प गएको पाइएको छ, जसको कारणले मानिसहरू घरबाहिर बसेका थिए र ठूलो मानवीय क्षति भएको थिएन ।

b-value मा परिवर्तन

साना भूकम्पहरू तथा ठूला भूकम्पबिच रहेको सम्बन्धलाई भूकम्प वैज्ञानिकहरू गुटेनबर्ग र रिक्टरले $log_{10}N = a - bM$ समीकरण मार्फत

स्थापित गरेका हुन् । दिइएको सम्वन्धमा *N* भनेको भूकम्पको संख्या हो जस्को म्याग्निच्युड *M* भन्दा बढी हुन्छ । *a* र *b* कन्स्टान्ट हुन् जसमा *b* भने *b-value* हो । यो *b-value* सामान्यत: करिब १ हुन्छ । ठूलो भूकम्प जानुपूर्व भूकम्पीय गतिविधि घट्ने भएकाले यस्को मान पनि घट्छ तर ठूलो भूकम्प गइसकेपछि भने यो पुरानै अवस्थामा फर्कन्छ । सामान्य अवस्थामा सानो *b-value* (साना भूकम्पको संख्या कम रहेको अवस्था) ले भूकम्पको स्रोतक्षेत्र कडा चट्टानले बनेको छ भन्ने जनाउँछ भने ठूलो *b-value* (साना भूकम्पको संख्या धेरै रहेको अवस्था) ले भने कमजोर चट्टानहरू रहेको सङ्केत गर्दछ ।

पृथ्वीको भित्री भागबाट हुने ग्यासको निष्काशनमा परिवर्तन

पृथ्वीको सतहमा रहेका भौगर्भिक भ्रंश (Geological faults) को माध्यमबाट पृथ्वीको भित्री भागबाट निरन्तर विभिन्न खालका ग्यासको निष्काशन भइरहेको पाइएको छ । यस्ता ग्यासमा रेडियोधर्मी रेडोन ग्यास, कार्बन डाइअक्साइड ग्यास तथा हाइड्रोजन सल्फाइड ग्यास आदि पर्दछन् । यस्ता ग्यासको निष्काशन दर ठूला भूकम्पहरू जानुभन्दा अघि निकै बढेर गएको विभिन्न अध्ययनहरूमा पाइएको छ । नेपालमा पनि हालै आएर यस्तो अध्ययन कार्य सुरु भएको छ । खानी तथा भूगर्भ विभाग र फ्रान्सको Institut de Physique du Globe de Paris (IPGS) को संयुक्त सहभागितामा रसुवा जिल्लाको स्याफ्रुबेसी क्षेत्रमा यस्तो अध्ययन गर्न थालिएको छ । भूकम्प जानुपूर्व पृथ्वीको गर्भमा चिराहरू बन्ने कारणले निष्काशन दरमा परिवर्तन आउने वैज्ञानिक विश्लेषण छ ।

जनावरको अस्वाभाविक व्यवहार

माथि उल्लेख गरिएका भूकम्पका पूर्वसूचकहरू बाहेक सर्प, मुसा, कुकुर, चरा तथा घोडाहरू जस्ता जनावरहरूले पनि विभिन्न ठूला भूकम्पहरू जानुभन्दा केही दिन अगाडि, सामान्य अवस्थामा पनि, अस्वाभाविक व्यवहार प्रदर्शन गरेको सुनिएको छ । जनावरहरूले धेरै कुरामा आफ्नो प्रतिक्रिया देखाउने गर्दछन् जस्मा भोक, यौनइच्छा, आफ्नो प्रभावक्षेत्रको सुरक्षा र शत्रुहरूको उपस्थिति आदि पर्दछन् । यस्ता अवस्थामा देखाउने व्यवहार र ठूला भूकम्पहरू जानु अगाडि, बिना कुनै स्पष्ट कारण, देखाउने व्यवहारमा फरक हुन्छ जो हामीले चिन्न सक्छौं । तर विश्वमा गएका सबै ठूला भूकम्पमा यस्तो व्यवहार भने देखिएको छैन । चीनमा गरिएको एक अनुसन्धानमा यस्ता प्रतिक्रियाहरू ठूलो भूकम्प जानु केही घण्टा देखि दुई-तीन दिन अगाडि देखिएको पाइएको छ । हालसम्म जनावरहरूमा बिना स्पष्ट कारण देखिएका यस्ता अनौठा तथा अस्वाभाविक व्यवहारहरूको सङ्क्षेपमा तल उल्लेख गरिएको छ । सन् १९७५ मा चीनको हाइचेंगमा गएको भूकम्पमा निम्न सङ्केत देखिए ।

१. बाख्राहरू आफ्नो खोरमा जान नमान्नु । २. बिरालाहरू, कुकुर हरू आफ्ना बच्चाहरू लिएर घरबाहिर जानु । ३. सुंगुरहरू अनौठो गरी कराउनु । ४. कुखुराहरू खोरबाट रातको समयमा पनि भाग्नु । ५. चराहरूले रातको समयमा पनि खोर छाड्नु । ६. चिडियाखानाका जनावरहरू राति आफ्नो खोरमा जान नमान्नु । ७. चीसोको समयमा पनि सर्प तथा मुसाहरू दुलोबाहिर जमिनमा आउनु । ८. गाई, भैंसीहरू अग्लो स्थानमा जान खोज्नु । ९. घरपालुवा जनावरहरू छट्पटिनु र अशान्त हुनु । १०. जंगली जनावरहरू आफ्ना स्वाभाविक वासस्थानहरू छाड्नु, आदि ।

सन १९७५, फरबरी को एक तारिखमा चीनको हाइचेंग शहरमा म्याग्नेच्युड ७.३ को भूकम्प गएको थियो तर भाग्यवश यसको भविष्यवाणि गरी शहर खाली गर्न प्रशासनले आदेश दिएको थियो । शहर खाली गरिएको कारणले गर्दा ठूलो म्याग्निच्यूड भएपनि निकै कम मानिसको मृत्यु भएको थियो । भूकम्मको कारणले शहरका अत्यधिक घरहरू नष्ट भएका थिए । भूकम्प जाने करिब एक महिना अघि ठूलो मात्रामा जनावरहरूका अनौठा व्यवहारहरूका समाचारहरू आएका थिए । भूकम्प जानु केही दिनपूर्व जाडोको मौसम र जमिनमा हिउँ जमेको समय भएतापनि जमिनमुनि बस्ने सर्पहरू hibernation छाडेर र मुसाहरू दुलो छोडेर जमिनमा आए, जो कठोर जाडोका कारणले मारिएका थिए । यसैबीच केही कडा पूर्वकम्पहरू पनि आएको हुँदा शहर खाली गर्ने आदेश (भविष्यवाणि) जारी भएको थियो ।

यसैगरी १९७६ मा चीनको तानसांग क्षेत्रमा एक शक्तिशाली भूकम्प (म्याग्निच्यूड ७.८) गएको थियो जस्को कारणले करिब दुई लाख पचास हजार मानिसले ज्यान गुमाएका थिए । यस भूकम्पको भविष्यवाणि गर्न सकिएको थिएन । भूकम्प जानुपूर्व उक्त क्षेत्रको नजिकै एक कृषकले आफ्ना खच्चर र घोडाहरूले आहारा खान नमानेको देखेका थिए । ती जनावरहरू लात्तीले हान्दै तथा उफ्रँदै आफूलाई बाँधेको डोरी फुस्काएर भागेका थिए ।

सन २००४ मा इन्डोनेशियामा गएको भूकम्प तथा उक्त भूकम्पले उत्पन्न गरेको चुनामीले ठूलो जनधनको क्षति भएको थियो । भारतको दक्षिण तथा श्रीलंकाबाट प्राप्त रिपोर्ट अनुसार चुनामी तटीय क्षेत्रमा आइपुग्नु अगाडि उक्त क्षेत्रका जनावरहरू त्यहाँबाट भागेर सुरक्षित क्षेत्रतर्फ गइसकेका थिए ।

नेपालमा बि. सं. १९९० को भूकम्प पछि एक लोककवि (श्री लोकनाथ पोखरेल, लोकमञ्जरी प्रकाशनमा) ले रचेको कवितामा सर्प लगायत अन्य जनावरहरूको मृत्यु भएको उल्लेख गरेका छन् । उक्त भूकम्प माघ २ गते जाडो महिनामा गएको कारणले जनावरहरू जमिन बाहिर आउँदा मृत्यु भएको हुनसक्छ र तिनिहरूले भूकम्पको पूर्वसङ्केत गरेका हुनसक्छन् ।

ठूला भूकम्प जानु पूर्व जनावरहरूमा देखिने अस्वाभाविक प्रतिक्रिया वास्तवमा अस्वाभाविक नहुन पनि सक्छन् र आउने भूकम्पको सङ्केत गरि राखेका हुन सक्छन् । ठूला भूकम्प जानु अघि जनावरहरूले किन अस्वाभाविक व्यवहार प्रदर्शन गर्दछन् यस विषयमा पनि विश्वमा थुप्रै अनुसन्धानकार्यहरू भएका छन् र भइरहेका छन् । ठूलो भूकम्प आउँदा

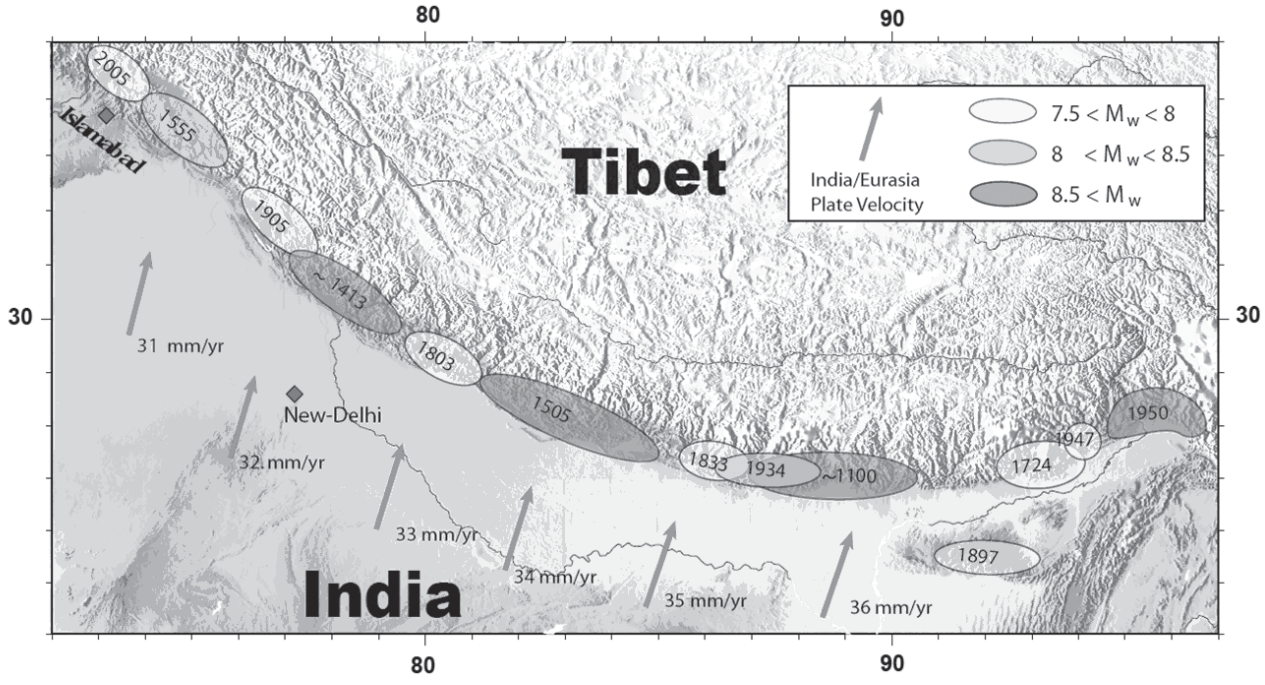
पहिले प्राइमरी वेभ आइपुग्छ र दूरी अनुसार केही समयपछि सेकेन्डरी वेभ आउँदछ, जो हामिले पनि अनुभव गर्न सक्दछौं । यस्तो अवस्थामा प्राइमरी वेभको कम्पनले नै जनावरहरू भाग्नसक्ने भएकाले बढी क्षति गराउन सक्ने सेकेन्डरी, लभ र रिले वेभको कम्पनबाट बचेका हुनसक्छन् । भूकम्प जानुपूर्व भूकम्प उत्पन्न गर्ने क्षेत्रमा हुने भौतिक तथा रासायनिक परिवर्तनका कारणले भूविद्युतीय तथा भूचुम्बकीय अवस्थामा परिवर्तन आउँछन् । यस्ता परिवर्तनप्रति जीवकोषहरू निकै सम्वेदनशील हुने गरेको पाइएको छ जसको कारणले उनीहरूले कम्पन सुरु हुनु केही समय अघि नै सम्भावित खतराको सूचना पाउने हुनसक्छ । ठूला भूकम्पहरू केही शय वर्षको अन्तरालमा मात्र जाने भएको हुँदा, उक्त समय भन्दा सानो जीवन भएका जनावरहरूले खतरा भनेर चिन्ने कुरा भने अनौठो छ । यसको उत्तर जान्न भन्दा पहिले हामीले जीव विकास क्रम बुझ्न भने जरुरी छ । जीव विकासक्रममा वातावरण अनुसार परिवर्तन आत्मसात गर्नसक्ने मात्र बाँच्न सक्छन र भूकम्पको वा यस्तै अन्य खतरा चिन्ने शक्ति जनावरहरूमा प्राकृतिक रुपमै आफ्ना बाबुआमाबाट वंशानुगत तथा प्राकृतिक रुपमा प्राप्त भएको हुनसक्छ ।

नेपालको पश्चिमी भागमा महाभूकम्प जाने सम्भावना किन ?

नेपाल हिमालय क्षेत्रमा उत्पन्न हुने भूकम्पहरूको प्रमुख कारण भारतीय टेक्टोनिक प्लेट निरन्तर रुपमा उत्तरतर्फ विस्थापन हुने क्रममा, हिमालयमा सञ्चित हुने दबाव र त्यसको विसर्जन हो । चित्र २ मा जिपिएस भेलोसिटीले (तीरहरू) देखाए जस्तै करिब ३.५ सेन्टिमिटरका दरले प्रत्येक वर्ष इन्डियन प्लेट उत्तरतर्फ सरिरहेको छ र यसक्रममा हिमालय क्षेत्रमा दबाव बढदै जान्छ । सयौं वर्षदेखि संचित भएर रहेको दबाव ठूला भूकम्पको माध्यमबाट क्षणभरमा विसर्जन हुने गर्दछ । गोरखादेखि पश्चिमको क्षेत्रमा हालसम्म गरिएका अध्ययनहरूबाट सन् १५०५ (चित्र २ हेर्नौं) यता महाभूकम्पहरू गएको पाइएको छैन । महाभूकम्प केही शय वर्षदेखि नगएको अवस्था नै नेपालको पश्चिम क्षेत्रमा महाभूकम्प जाने अनुमानको आधार हो । उक्त क्षेत्रमा अहिले आठ म्याग्निच्यूड भन्दा ठूलो भूकम्पको लागि पर्याप्त ऊर्जा जम्मा भइसकेको अनुमान छ ।

निश्कर्ष

भूकम्प नेपाल लगायत हिमालय तथा टेक्टोनिक प्लेटका सिमानाहरूका लागि एक नियमित प्रक्रिया हो । साना भूकम्पहरू दैनिक आइरहेका



चित्र २: हिमालय क्षेत्रमा ठूला भूकम्पले असर पारेका अनुमानित क्षेत्र (rupture area) । तीरहरू जिपिएस भेलोसिटि हुन्, इलिप्सहरू rupture area हुन् र इलिप्सभित्र उल्लेख गरिएका मितिले भूकम्प गएको साल ईस्वी सम्वत्मा जनाउँछन् । (स्रोत: बेटिनेली आदि २००५)

हुन्छन् भने ठूला भूकम्पहरू केही दशक तथा केही शताब्दि पछि आउने गर्दछन्। भूकम्पहरू दोहोरिएर आउने प्रक्रियालाई भूकम्प चक्र भन्दछन्। ठूला भूकम्पहरूको राम्रो अध्ययन भएका क्षेत्रहरूमा अब पालो कुन क्षेत्रको भन्ने अनुमान गर्न सकिनुका साथै सोही क्षेत्रमा पहिले महाभूकम्प गएको वर्ष तथा उक्त भूकम्पको म्याग्निच्यूडको आधारमा उक्त क्षेत्रमा कति वर्षको अन्तरालमा कत्रो भूकम्प आउनसक्छ भनि अनुमान गर्न सकिन्छ।

ठूलो भूकम्प कुनै क्षेत्रमा गइसकेपछि उक्त क्षेत्रमा भूकम्पको विषयमा निकै सतर्कता जनस्तरमा तथा सरकारी स्तरमा बढ्ने गरेको पाइएको छ, जो स्वाभाविक पनि हो। महाभूकम्प गइसकेका क्षेत्रहरूमा छिटै (शय वर्ष भित्रै) त्यस्तै भूकम्प आउने सम्भावना कम हुन्छ भने उक्त क्षेत्रको आसपासमा भने यसको सम्भावना बढेर जान्छ। नेपालमा सन् ११०० देखि यता ठूला भूकम्प गएका प्रमाणहरू पाइएका छन् जसमध्ये केहीले जनधनको क्षति पुऱ्याएको इतिहासमा उल्लेख गरिएको छ। यसबाट के प्रष्ट हुन्छ भने इतिहासमा महाभूकम्प गएर जन-धनको क्षति पुऱ्याए जस्तै भविष्यमा पनि यस्ता महाप्रलयकारी भूकम्प जान सक्छन् किनभने हिजोका भूकम्प उत्पन्न गर्ने कारण आज पनि विद्यमान छन्।

सन् १९०५ मा भारतको कांगरामा तथा सन् १९३४ (वि. सं. १९९०) मा नेपालको पूर्विभागमा यस्ता ठूला प्रकृतिका भूकम्पहरू गइसकेको र उक्त क्षेत्रको बिचमा पर्ने भागमा सन् १५०५ यता यस्ता भूकम्प गएको नपाइएको हुँदा अब महाभूकम्प जाने सम्भावित क्षेत्र भनेको नेपालको गोरखादेखि पश्चिम तथा भारतको कांगरादेखि पूर्वको क्षेत्र हो किनभने उक्त दुई शक्तिशाली भूकम्प गएका क्षेत्रमा अब पुनः भूकम्प दोहोरिन केही शय वर्ष लाग्नेछ र निकट भविष्यमै (शय वर्ष भित्रै) त्यस्तै भूकम्प आउने सम्भावना कम भएको छ तर म्याग्निच्यूड आठ भन्दा साना भूकम्पको सम्भावना भने उक्त दुई क्षेत्रमा (नेपालको पूर्वी क्षेत्र र भारतको कांगरा क्षेत्र) नकार्न सकिँदैन (चित्र २)। यदि महाभूकम्पहरू नेपालको पश्चिमी क्षेत्रको इतिहासमा लेखिन नछुटेका भए, उक्त क्षेत्रमा Indian Plate भूकम्पहरू उत्पन्न नगरिकन Tibetan Plate मुनि घुसिरहेको (aseismic creep) नभए र सञ्चित ऊर्जा सुस्त भूकम्पहरू (slow earthquake) को माध्यमबाट विसर्जन नभएको भए महाभूकम्प नगएको करिब पाँच शय वर्ष भइसकेको छ। यसरी लामो समयदेखि महाभूकम्प नजानुको अर्थ उक्त क्षेत्रमा महाभूकम्प जाने सम्भावना अन्य क्षेत्रभन्दा अत्यधिक बढी छ, तर भूकम्प जाने समयको अनुमान गर्न भने सम्भव छैन। भविष्यमा, छिटै, यस्तो प्रश्नको भरपर्दो जवाफ आउन सक्ने सम्भावना पनि अहिलेसम्म देखिएको छैन।

बेलाबेलामा गैर वैज्ञानिक क्षेत्रबाट गरिने भूकम्पको भविष्यवाणिमा कुनै वैज्ञानिक आधार हुँदैन र त्यस्तो भविष्यवाणिको पछि लागेर समय र स्रोतको पनि वर्वाद नगरौं। हामीले महसूस गर्न सक्ने भूकम्पका झटका छोटो समयमा बारम्बार आएमा अलि सतर्क भएर बसौं किनकि यी ठूलो भूकम्पका पूर्वसूचक पनि हुन सक्दछन्। आजैदेखि भूकम्प गइहालेको खण्डमा बच्न अपनाउनुपर्ने सुरक्षाका उपायहरूको बारेमा राम्रो जानकारी राखौं र तयारी पनि गरौं।

भूकम्प विज्ञान एक नयाँ विज्ञान हो, जो अहिले पनि विकासको क्रममा छ। भूकम्पको भविष्यवाणिको लागि हालसम्म भएका कार्यहरू अपूरा छन किनभने ठूला भूकम्पहरू विरलै जान्छन् र एक व्यक्तिको सक्रीय जीवनकालमा एउटै ठाउँमा दोहरिएर ठूलो भूकम्प आउने सम्भावना निकै कम हुन्छ, जसले गर्दा अनुसन्धानकर्ताहरूले यसलाई आफ्नो जीवनमा पूर्णता दिन सक्दैनन्। अहिलेसम्म भूकम्प विना सूचना आउँछ भन्ने सोचाइ विद्यमान छ तर भूकम्प आउनुपूर्व यस्ले दिने सूचनाहरू हामीहरूले नचिनेको पनि हुन सक्छ किनभने यो विज्ञानको नवीन अनुसन्धान क्षेत्र हो जो अझै पूर्ण छैन।

हालसम्म तत्काल जाने भूकम्पको भविष्यवाणिको लागि अपनाइएका प्रविधिहरू परिक्षणकै क्रममा छन्। भूकम्पको भविष्यवाणिको लागि भइरहेका प्रयासहरूलाई विश्राम दिनु हुँदैन, बरु थप प्रयास आवश्यक छ। भूकम्प जानुअघि विभिन्न किसिमका सङ्केतहरू पनि देखिएको पाइएको छ, तर एक ठाउँमा देखिएका सङ्केतहरू अर्को ठाउँमा नदेखिने गरेका छन् भने देखिएका ठाउँहरूमा पनि भूकम्प आएका छैनन्। विभिन्न देशमा देखिएका भूकम्पका पूर्वसूचकहरूको अन्य क्षेत्रका साथै त्यही क्षेत्रमा समेत अन्य ठूला भूकम्पहरूको सन्दर्भमा सम्बन्ध पुष्टि हुन सकेको छैन, किनभने ठूला भूकम्प ती क्षेत्रमा दोहोरिएर गएका छैनन्। भूकम्पको भविष्यवाणिको लागि विश्वले काम गर्न थालेको अहिले झण्डै चालिस वर्ष भएको छ, तैपनि अत्याधुनिक प्रविधिको विकास भएको भर्खर मात्रै हो। चालिस वर्षको समय, भूकम्प दोहोरिएर कुनै एक क्षेत्रमा आउने समय भन्दा निकै कम भएको हुँदा पनि (ठूला) भूकम्पको भविष्यवाणिमा सफलता पाउन नसकिएको हो किन भने उक्त क्षेत्रमा कम्तिमा पनि एक पटक दोहोरिएर आएका (दुई) भूकम्पहरूको अध्ययन कार्य पूरा भएको छैन जसले गर्दा भूकम्पको चक्र (earthquake cycle) को ज्ञान हामीसँग छैन। भूकम्प चक्रको राम्रो ज्ञान भएका अवस्थामा तथ्याङ्क कै आधारमा भएपनि भूकम्प दोहोरिएर आउने समय अनुमान गर्न केही सहयोग पुग्थ्यो।

माथि उल्लेख गरिएका विभिन्न कारणहरूले गर्दा भूकम्प जाने समयको भरपर्दो भविष्यवाणिको अहिले तथा तत्काल भविष्यमा सम्भावना छैन। भूकम्प जाने समयको भविष्यवाणि गर्न नसकिएता पनि भूकम्पका उदाहरणहरूको प्रयोग गरेर, स्थानविशेषको भौगर्भिक बनावटका आधारमा उक्त स्थानमा भूकम्पको तीव्र कम्पनको भविष्यवाणि गर्न थालिएको छ र सतर्कता अपनाउन थालिएको छ। नेपालको सन्दर्भमा भन्नुपर्दा काठमाडौं लगायत तराई जस्ता कमजोर भौगर्भिक बनावट भएका स्थानहरूमा भूकम्पको असरबाट जन-धनको क्षति कम गर्न ती क्षेत्रहरूको भूकम्पीय शुक्ष्म विभाजन (seismic microzoning) गरी प्राप्त परिणाम अनुसार दीर्घकालीन नीति तर्जुमा गर्न अति आवश्यक छ।

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पर्यावरण मासिक, अंक ८, माघ, २०६३, पूर्णांक ७१, इको नेपाल, काठमाण्डौ

LETTER TO THE EDITOR FROM DR SANGITA CHOWDHURY REPORTING A CASE OF PLAGIARISM

The Editors,
Indian Journal of Geology
Geological, Mining and Metallurgical Society of India
Geology Department
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35, Ballygunj Circular Road
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From
Dr. Sangita Chowdhury
DST Women Scientist
Department of Geology
University of Calcutta
35 Ballygunj Circular Road
Kolkata- 700019
Dated: 18th March, 2009

Sub. Charge of Plagiarism

Dear Sirs,

Kindly refer to the paper "Lead dominant sulfide mineralization in the Sargipalli lead deposit in the Proterozoic fold belt of Gangpur Group: its geology, control of mineralisation and metallogeny" by S. P. Ghosh, M. M. Mukherjee and P. K. Jena **(Indian Journal of Geology, Vol. 78, Nos. 1-4, 2006, p. 215-228)** published in your reputed journal in January, 2009. I am shocked to point out that the authors copied line by line most of the portion of their paper from my paper "The Sargipali sulphide deposit of Orissa, India: its atypical lead-high character and genesis". **Journal of Nepal Geological Society, 2002, Vol. 27** (Special Issue), which was not cited in their paper, and few portions of our paper "Lead and sulphur isotope geochemistry of galena from Sargipali sulfide deposit, Sundargardh, Orissa - Implications for ore genesis", S. Ghosh, R. I. Thorpe and A. K. Ghosh (Corresponding author), **Indian Journal of Earth Sciences, Vol. 26, Nos. 1-4, p. 1-12, 1999** (cited in their paper).

In this paper, they have no contribution, only summed up the contents of papers- Ghosh et al. 1999, Vishwakarma and Ulabhaje, 1991. Vishwakarma, 1996, and Chowdhury, 2002. They even did not give their own interpretation. In the 'Summary and Conclusion' part among the four points, the points 2, 3, and 4 were totally copied from my paper (Given below). In the sum-up of their work (page 225, last para) they cited the references of Franklin et al. 1981, Franklin, 1986. But in fact J. M. Franklin personally communicated those opinions to me which were cited in my paper with his other references (page 22- 8th paragraph of caption 'Discussion').

In support of their work on mineralization, they didn't give and photograph. Their "Lead and Sulphur isotope study" is based on sulphur isotope analyses of only two galena samples. Their lead isotope study was based only on our data (Ghosh et al. 1999) and data of Vishwakarma and Ulabhaje (1991). They gave no suggestion or interpretation about the result of lead isotope, only repeated our conclusion.

The author suggest 'SEDEX' mode of origin of the deposit without citing any evidence. It may be suggested that only two sulphur isotope analyses are not enough to conclude about the genesis of a deposit.

I am giving comparison of my paper and copied paper below in the tabular form. The slight differences between two write-ups are marked bold.

This is a clear case of plagiarism. Therefore, I would request you to kindly publish my letter as a 'Discussion' in the next issue of your esteemed Journal. I would also like to request you to take necessary action regarding this issue so that such incident does not occur in future.

Thanking you,
Yours faithfully,

Sangita Chowdhury

Sangita Chowdhury

Comparison of the contents of paper by S. P. Ghosh, M. M. Mukherjee and P. K. Jena, 2009 with the paper of Sangita Chowdhury, 2002, and that of S. Ghosh, R. I. Thorpe and A. K. Ghosh, 1999

Indian Journal of Geology, Vol. 78, Nos. 1-4, 2006, p. 215-228 by S. P. Ghosh, M. M. Mukherjee and P. K. Jena	**Journal of Nepal Geological Society, 2002, Vol. 27 (Special Issue), pp. 11-24 by Sangita Chowdhury**
Under head 2. **'Geology of Sargipalli Lead Deposit'**	Under head **'Geological Setting'**
Page 217, 2nd column from previous line of the last line to page 218-end of that paragraph.	Page 13, 2nd paragraph, 6th to 8th line
"The contacts of all the rock types are gradational except the granitoid rock, which has a sharp contact with the other rock".	"The contacts of all the rock types are gradational except the granitoid rock, which has a sharp contact with the other rock".
	11th to 16th lines
"Endoskarn has developed at the contact of dolomite and granitoid. The conspicuous feature of this area is the presence of tourmaline- quartz schist (tourmalinite) in which tourmaline and sulfide layers alternate with the quartz layers, cherty laminations and actinolite **bearing** quartzites".	"Endoskarn has **been** developed at athe contact of dolomite and granitoid **rocks.** The conspicuous feature of this area is the presence of tourmaline-quartz schist (Tourmalinite) in which tourmaline- sulfide layers alternate with the quartz layers, cherty laminations and **rich proportions of** actinolite **minerals** in quartzites".
Page 218, 1st column, 3rd to 10th lines of 1st paragraph	Under sub heading 'Mica schist' page 13, 2nd line to 9th line.
"Mica schist in the mineralized zone is garnetiferous, but garnet is totally absent in the mica schist south of the mineralized zone. Mineralogically, the rock is divisible into **several** sub-units, which are not mappable in the field. These sub-units vary form muscovite-biotite schist to biotite-muscovite schist with presence or absence of various minerals (viz. garnet, kyanite, sillimanite, chlorite, potash feldspar and plagioclase **feldspar)**".	"Mica schist in the mineralized zone is garnetiferous, **while** south of the mineralized zone, garnet is totally absent in the mica schist. Mineralogically, the rock is divisible into **eight** sub-units vary form muscovite-biotite schist to biotite-muscovite schist with presence or absence of various minerals like garnet, kyanite, sillimanite, chlorite, potash feldspar and plagioclase".
Page 218, 1st paragraph, 13th to 18th line of 2nd column	Page 14, 4th to 8th line of 1st column
"The schistose rock is the metamorphosed product of the politic and semi-pelitic rock, ranging in composition from quartz-wacke to quartzose clay, and aluminium rich clay shales to feldspathic clay"	"The schistose rock is the metamorphosed product of the politic and semi-pelitic rock, ranging in composition from quartzwacke to quartzose clay, and aluminium rich clay shales to feldspathic clay **(Ghosh, 1998)**"
From last line, 2nd column of page 218 to 5th line, 1st column of page 219.	Under sub heading 'Quartzite and quartz schist' page 14, 3rd line to 8th line of 2nd column.
"Presence of cherty laminations, actinolite (with epidote and chlorite) and albitic plagioclase in quartzite and quartz schist indicate the derivation of these rock from greywacke that initially had a significant component of volcanic rock fragments"	"Presence of cherty laminations, actinolite (with epidote and chlorite) and albitic plagioclase in quartzite and quartz schist indicate the derivation of these rock from greywacke that initially had a significant component of volcanic rock fragments (William et al. 1985)".
4th line, 2nd column of page 220 to 10th line, 1st column of page 221.	Page 15, 1st column, 3rd paragraph, 4th line to last line of the same paragraph.

"Krishnan (1937) is of opinion that the rocks of the Gangue basin are folded into an ENE-WSW trending anticlinorium plunging towards East. Banerjee (1968) suggested that the area represents an easterly plunging regional reclined fold, later refolded into an antiform. Later workers (Kanungo and Mahalik, 1967: Sarkar, 1974: Chaudhuri and pal, 1983) proposed an opposite view suggesting that the Gangue rocks are folded into a synclinorium **(Fig. 3)** plunging westward. The synclinal nature of the main fold is suggested in the present study by the northerly younging direction of the southern limb. Direction of the truncated top of the current bedding is opposite to the dip directions of the southern limb".

Under head 3, **" Mineralisation"**

Page 221-222 from 27th line of 1st paragraph to last line of 2nd paragraph, 2nd column of page 222.

"The ore lenses are conformable with the host schists. The mineralization is mainly banded, with an alternate disposition of sulphide and silicate layers, even in micro-scales reflecting a straitform nature. Locally, however, ore veins occur discordant to the schistosity, filing fractures of host rock".

"Minor disseminations of sulphide are present in the vicinity of the ore lenses in mica schist as well as in the adjacent dolomite and calc-silicate skarn".

"Stratabound and stratified sulphide showing evidence of soft sediment deformation (primary sedimentary contortion of the ore and host rock layers) appear to reflect the primary, sedimentary and diagenetic process. Superimposed on these are the structure and textures mainly due to recrystallisation and annealing in response to subsequent metamorphism. Plastic deformation of galena and chalcopyrite are evidence by fracture filling of these minerals inside silicates. Mechanical deformation feature in coarse galena grains is identified by serrated boundaries and bent cleavages which possibly developed under low temperature (below 200° C and pressure conditions (McClay, 1980)".

"The effects of metamorphism are clearly recognized in the Sargipali basemetal sulphide. Recrystallisation and annealing are shown by the polygonal fabric and triple point junctions of galena, sphalerite and chalcopyrite.

"However, Krishnan (1937) suggested that that the rocks of the Gangue basin are folded into an ENE-WSW trending anticlinorium plunging towards East. Banerjee (1968) is of opinion that an easterly plunging regional reclined fold, later refolded into an antiform. While Later workers (Kanungo and Mahalik, 1967: Sarkar, 1968: Chaudhuri and pal, 1983) proposed an opposite view suggesting that the Gangue rocks are folded into a synclinorium plunging westward. The synclinal nature of the main fold is suggested in the present study by the northerly younging direction of the southern limb (direction of the truncated top of the current bedding is opposite to the dip directions of the southern limb)".

Under head **" ORE BODIES"**

Page 15, 2nd paragraph- 1st to 5th lines

"The ore lenses are conformable with the host schists **(Fig. 5a, b)**. The mineralization is mainly banded, which is characterized by an alternate disposition of sulphide and silicate layers, even in micro-scales **(Fig. 6a, b)** reflecting a straitform nature. Locally, however, ore veins occur discordant to the schistosity, filing fractures of host rock".

Last line of page 15 to 2nd line of 1st column of page 16.

"Besides, minor disseminations of sulphide are present in the vicinity of the ore lenses in mica schist as well as in the adjacent dolomite and calc-silicate skarn".

Page 16. 2nd and 3rd para of 1st column.

"Stratabound and stratified sulphide showing evidence of soft sediment deformation (primary sedimentary contortion of both ore and host rock layers) appear to reflect the primary, sedimentary and diagenetic process **(Fig. 6a)**. Superimposed on these are the structure and textures mainly due to recrystallisation and annealing in response to subsequent metamorphism.
Plastic deformation of galena and chalcopyrite are evidence by the fracture filling of silicates by these minerals **(Fig. 7a)**. Mechanical deformation feature in coarse galena grains is identified by serrated boundaries and bent cleavages which possibly developed under low temperature (below 200° C and pressure conditions (McClay, 1980)".

Page 16. 2nd column, 1st to 5th line.

"The effects of metamorphism are clearly recognized in the Sargipali sulphides. Recrystallisation and annealing are shown by the polygonal fabric and triple point junctions of galena, sphalerite, chalcopyrite, and Pyrrhotite **(Fig. 8a, 9b, c, d)**.

	Under head **"DISCUSSION"**
	From 5th line to 13th line of 3rd paragraph
"There is also no visible wall-rock alteration in the host rock which is indicative of the epigenetic mineralization, where ore –fluid reacts with the host rock. The granitioid rock of the area as source of mineralisation can be outright rejected because of its intrusive nature much younger age (~ 850 Ma) in comparison to the host rock (~ 1700 Ma) and the contained ore (range between 1682 Ma and 1695 Ma). The skarn rocks, which are formed by metasomatic alteration of dolomite at the contact of granitoid, are barren **of any mineralisation**".	"There is also no visible wall-rock alteration in the host rock which is indicative of the epigenetic mineralization, where ore –fluid reacts with the host rock. The granitioid rock of the area can be outright rejected to be a source of mineralization because of its intrusive nature much younger age (~ 850 Ma) in comparison to the host rock (~ 1700 Ma) and the contained ore (range between 1682 Ma and 1695 Ma). The skarn rocks, which are formed by metasomatic alteration of dolomite at the contact of granitoid, are barren".
	Page 21 &22. 4th and 5th paragraph
"**The characteristic** feature of the sediment-hosted deposit is the presence of anomalous, apparently syngenetic metal values in **the** footwall sediments. Manganese appears fist, followed by zinc ± lead, iron and exhalative chert **higher up in the footwall sequence**. The footwall sediment of Sargipalli is enriched in lead at deeper mine level (120 mRL). The sulfide **rich** footwall is characterized by pyrrhotite-rich bands and laminations, similar to the sediments-hosted sulphide deposit of Sullivan, Canada (Ransom, 1977). Locally bedded chert and tourmalinite of exhalative origin are closely associated with the ore zone. The vertical distribution of copper in **the** sediment hosted deposit contrast with that in volcanic hosted deposits. Relatively late copper enrichment is observed in many exhalative deposits. In Sargipali hanging wall rocks are rich in chalcopyrite.	"**A** feature of the sediment- hosted deposit is the presence of anomalous, apparently syngenetic metal values in footwall sediments. Manganese appears fist, followed **higher in the footwall sequence** by zinc ± lead, iron and exhalative chert. The footwall sediment of Sargipalli is enriched in lead, **but** at deeper mine level (120 mRL) the sulfide footwall is characterized by pyrrhotite-rich bands and laminations **like** the sediments-hosted sulphide deposit of Sullivan, Canada (Ransom, 1977). Locally bedded chert **(Vishwakarma 1996)** and tourmalinite of exhalative origin **(Williner 1992)** are closely associated with the ore zone. The vertical distribution of copper in the sediment hosted deposit contrast with that in volcanic-hosted deposits. Relatively late copper enrichment is observed in many exhalative deposits **(Maithias et al. 1973: Whitcher 1975)**. In Sargipali hanging wall rocks are richer in chalcopyrite.
	Under head **"INTRODUCTION"**
Page 222. 2nd column, 5th line 10th line of last paragraph	Page 11. 1st column, 8th line of 2nd paragraph to 2nd line of second column.
The ore reserve, **in the deposit** is of the order of 2.06 million tones, having an average grade of 6.73% Pb. 0.33% Cu and about 50 ppm **of** Ag. The Zn content in the ore is insignificant (the average grade being 0.4%) **and is** below recovery limit.	The ore reserve, **based on the total drilling coverage of 14,087 m in 100 boreholes** is of the order of 2.06 million tones, having an average grade of 6.73% Pb. 0.33% Cu and about 50 ppm Ag **(Unpublished report of HZL; Pattnaik and Raju 1990).** The Zn content in the ore is insignificant (the average grade being 0.4%, **Sarkar, 1974**), below recover**able** limit.
Under hear 5. **"Metallogeny"**	Under head **"DISCUSSION"**
Page 225, last paragraph	Page 22, last paragraph of 1st column, continued to 12th line of 2nd column
"Considering all the facts mentioned above, it appears that the lead-dominant mineralization **at** Sargipalli contains well homogenized lead, derived possibly from upper crustal	**"From the above discussion,** it appears that the lead-dominant Sargipali mineralization contains well homogenized lead, derived possibly from upper crustal felsic

felsic terrains below or adjacent **(?)** to the basin, and the metal was discharged through hydrothermal vents to the basin floor. The metal content of the hydrothermal fluids, as envisaged here was established by the buffering capacity of the host rocks, as well as by the actual metal content of these rocks (Franklin et al. 1981; Franklin, 1986). During cooling if the fluid is reduced and the pH is acidic, copper followed by zinc precipitate leaving the residual liquid **to be** relatively enriched in lead. In Sargipalli lead is considered to have been derived from **the** uranium enriched, felsic upper crustal source (Ghosh et al. 1999; Vishwakarma and Ulabhaje, 1991). Franklin (1986) suggested that **the** phase separation of a fluid can change its metal ratios, as well as its complex characteristics. Hydrothermal fluids in felsic rocks or sediments are buffered by mica to a low pH at relatively low temperature (300°C). Deposits in such terrains are therefore more lead rich (relative to copper and zinc) as in the case of Sargipalli".

terrains below or adjacent to **(?)** the basin, and the metal was discharged through hydrothermal vents to the basin floor. **Franklin et al. 1981; Franklin, 1986, (<u>personal communication</u>) suggested that** the metal content of the hydrothermal fluids, as envisaged here, is established by the buffering capacity of the **source** rocks, as well as **possibly** by the actual metal content of these rocks. During cooling, **provided that** the fluid is **always** reduced and the pH is acidic, copper, **then** zinc **will** precipitate leaving the residual liquid relatively enriched in lead. In Sargipali lead is considered to have been derived from uranium enriched, felsic upper crustal source (Ghosh et al. 1999; Vishwakarma and Ulabhaje, 1991). Franklin (1986, **personal communication)** suggested that phase separation of a fluid can change its metal ratios, as well as its complex**ing** characteristics. Hydrothermal fluids in felsic rocks or sediments are buffered by mica to a low pH at relatively low temperature (**Ca.** 300°C). Deposits in such terrains **will be,** therefore, more lead rich (relative to copper and zinc) as in the case **at** Sargipali".

Page 22, 18th to last line of the 1st paragraph of 2nd column.

"Some remobilization of pre-existing minerals, mostly the ductile phases took place during regional metamorphism. But this mobilization involved limited transport distance of the order of millimeters to meters".

"Some remobilization of pre-existing minerals, mostly the ductile phases took place during regional metamorphism. But this mobilization involved limited transport distance of the order of millimeters to meters".

Page 21, 1st paragraph of 2nd column

Under head **5. " Summary and conclusions"** page 226

2. Geological features of the Sargipalli lead deposit indicate that the sediment hosted lead dominant sluphide deposit of the area is strictly stratabound and stratiform in nature. The ore lenses are parallel to the compositional layering of the associated metasedimentary rocks. The ore laminae alternate with the layers of the host schist. Textural studies did not give any evidence to suggest that the ore layers selectively replaced the silicate layers anywhere. The silicate layering is primary, supported by the presence of rounded tourmaline grains. Frequent contortions of both the ore and the silicate layers are strongly indicative of the effects of diagenesis.

"Geological features **observed above** indicate that the sediment-hosted lead-dominant sulphide deposit of **Sargipali** is strictly stratabound and stratiform in nature. The ore lenses are parallel to the compositional layering of the associated metasedimentary rocks. The ore laminae alternate with the layers of the host schist. Textural studies did not give any evidence to suggest that the ore layers selectively replaced the silicate layers anywhere. **On the other hand**, the silicate layering is primary, supported by the presence of rounded tourmaline grains. Frequent contortions of both the ore and the silicate layers **(Fig. 6a)** are strongly indicative of the effects of diagenesis, **and these above mentioned features indicating their exhalative origin (Murry, 1975; Taylor and Andrew, 1978)".**

Page 22, 2nd paragraph of the 1st column

3. The extremely homogeneous lead isotopic composition and high metal value of lead indicate derivation of lead from uranium-enriched felsic upper crustal source. The sulphur **isotope analysis of galena samples from the Sargipalli deposit shows a range of $d^{34}S$ values from -4.4 to +5.3 %. The widely separated $d^{34}S$ values in the given range are**

The extremely homogeneous lead-isotopic composition and high metal value of lead **of Sargipali galena (Ghosh et al. 1999)** indicate **the** derivation of lead from uranium- enriched felsic upper crustal source. The sulphur-isotope **values** of galena show a **moderate spread indication inorganic or biogenic sediment source of sulphur (Ghosh et al. 1999)**.

in general characteristic of deviation of sulphur due to sulphate reduction within a limited reservoir in a sedimentary domain and bears no mantle signature (Neilson, 1979). According to Vishwakarma (1996) there may be the possibility of a sulphur source mainly form inorganic reduction of seawater sulphate at a temperature of ~300° C. Presence of pyrrhotite-rich bands and laminations in the deeper mine levels also indicate the reducing environment of ore deposition. The absence of oxidized zones around the ore body supports the view.

4. Based on the above, it appears that the lead dominant mineralization at Sargipalli contain well homogenized lead, derived possibly from upper crustal felsic terrains below or adjacent (?) to the basin.

The metal content of the hydrothermal fluids, was buffered by the host rocks as well as by the actual metal content of these rocks,

The lead-dominant sulfide mineralization at Sargipalli represents sedimentary exhalative (SEDEX) mode of origin, which later remobilized and reconcentrated due to high grade metamorphism. According to Vishwakarma and Ulabhaje (1991), Vishwakarma (1996), lead was derived from the upper continental crust, possibly the 2.20Ga old Soda Granite of Singhbhum which was rich in U-Th-Pb.

According to Vishwakarma (1996) there may be the possibility of a sulphur source mainly form inorganic reduction of seawater sulphate at a temperature of ~300° C. Presence of pyrrhotite-rich bands and laminations in the deeper mine levels also indicate the reducing environment of ore deposition. The absence of oxidized zones around the ore body supports the view.

Page 22, 1st column, last para 1st line to 4th line

From the above discussion, it appears that the lead dominant **Sargipali** mineralization contain well homogenized lead, derived possibly from upper crustal felsic terrains below or adjacent **to** (?) the basin.

6th line to 10th line

Franklin et al. 1981; Franklin, 1986, (<u>personal communication</u>) suggested that the metal content of the hydrothermal fluids, **as envisaged here**, **is established by the** buffering **capacity of** the **source** rocks, as well as by the actual metal content of these rocks,

2nd column 2nd, para

In summary, therefore, the lead-dominant sulfide mineralization **of** Sargipalli represents sedimentary exhalative (SEDEX) mode of origin, which later remobilized and reconcentrated due to high grade metamorphism. According to Vishwakarma (1996), lead was derived from the "upper continental crust", **the source rock** possibly **being** the 2.20-Ga-old **Singhbhum** Soda Granite which was **initially** rich in U-Th-Pb.

Indian Journal of Geology, Vol. 78, Nos. 1-4, 2006, p. 215-228 by S. P. Ghosh, M. M. Mukherjee and P. K. Jena

Under head **5. " Metallogeny"**

Page 224, second paragraph

"According to Sangster (1976), the average fractionation of difference in $d^{34}S$ values between seawater sulphate and sulfide ores hosted in marine sedimentary rocks is 14%. Though Strauss (1997) emphasized that the sulphur isotopic composition of sea water sulphate and its evolution through time is yet not fairly known, Mesoproterozoic sea water

Indian Journal of Earth Sciences, vol. 26, Nos. 1-4, p. 1-12, 1999 by S. Ghosh, R. I. Thorpe and A. K. Ghosh

Under head "GENETIC IMPLICATION"

Page 9, 14th line of 1st paragraph, 2nd column to page 10, 1st column, 1st 12 lines.

"According to Sangster (1976), the average fractionation **or** difference in $d^{34}S$ values between seawater sulphate and sulfide ores hosted in marine sedimentary rocks is 14%. Though Strauss (1997) emphasized that the sulphur isotopic composition of sea water sulphate and its evolution through time is yet not fairly known, **assuming that Middle**

sulphate had an average $d^{34}S$ of 18% (Claypool et al. 1980). The Sargipali data (14.4%, **according to** Vishwakarma, 1996) are consistent with a sedimentary (sea water sulphate) source. Although the present data are too meager to make any generalization; the $d^{34}S$ values give indication of isotopic variation from 120.00 mRL to 210.00 mRL in the Sargipali mine (Table 2). Whether such a variation will support an overall enrichment of isotopic ratios towards higher stratigraphic horizons (i.e. from 120 mRL to 210 MRL) as suggested by Vishwakarma (1996) is indeed difficult to estimate. However, the isotopic variation between **the** two levels of Sargipali **lead** mines **(viz. between 120.00 mRL and 210.00 mRL with 120 m and 30 m depths below the surface shows a range of values form -1.7 to + 0.8%)**. This indicates that the amphibolite-facies metamorphism have not homogenized the primary distribution of $d^{34}S$ values (Von Gehlem et al. 1983; Parr, 1992; and Vishwakarma, 1996). The variation of $d^{34}S$ values might result from the reduction of seawater sulphate by inorganic processes or by bacterial action (Deb, 1986; Spry, 1987)".

Page 225, 1st column, from 26th line to last line of the 1st para.

"The metal-rich hydrothermal fluid, as envisaged, acquired reduced sulphur in the basin. **As** a result, sulphide precipitated at suitable sites conformably with the sediments, giving rise to synsedimentary ore formation. This model seems to be in close agreement with the ideas expressed earlier by Rai et al. (1988), Vishwakarma and Ulabhaje (1991) and Vishwakarma (1996)".

Proterozoic sea water sulphate had an average $d^{34}S$ of 18% (Claypool et al. 1980), **the** Sargipali data (14.4%, **according to** Vishwakarma, 1996) are consistent with a sedimentary (sea water sulphate) source.

Although the present data are too meager to make any generalization; the $d^{34}S$ values give indication of isotopic variation from 120.00 mRL to 210.00 mRL in the Sargipali mine (Table 2). Whether such a variation will support an overall enrichment of isotopic ratios towards higher stratigraphic horizons (i.e. from 120 mRL to 210 MRL, **Table 2**) as **voiced** by Vishwakarma (1996) is indeed difficult to estimate. However, the isotopic variation between two levels of Sargipali mine **would certainly indicate** that the amphibolite-facies metamorphism have not homogenized the primary distribution of $d^{34}S$ values (Von Gehlem et al. 1983; Parr, 1992; and Vishwakarma, 1996). The variation of $d^{34}S$ values might result from the reduction of seawater sulphate by inorganic processes or by bacterial action (Deb, 1986; Spry, 1987)".

Page 10, 2nd column, 11th line to last line.

"The metal-rich hydrothermal fluid, as envisaged, acquired reduced sulphur in the basin **and as** a result, sulphide**s** precipitated at suitable sites conformably with the sediments, **representing** synsedimentary ore formation. This model seems to be in close agreement with the ideas expressed earlier by Rai et al. (1988), Vishwakarma and Ulabhaje (1991) and Vishwakarma (1996)".

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Vushwakarma, R. K., and Ulabhaje, A. V. 1991. Sargipali galenas: unusual lead isotopes data from eastern India. Mineralium Deposita **26**, 26-29.

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Note: The Nepal Geological Society strongly condemns this case of blatant plagiarism and demands that the culprits are punished severely.

- Editors

CONGRATULATIONS

The Nepal Geological Society expresses its hearty congratulations to Dr. Dinesh Chandra Devkota, NGS Life Member (LM 558) for his nomination by the Government of Nepal as an **Honorable National Planning Commission Member** in January 2009.



Dr Dinesh Chandra Devkota

The Nepal Geological Society congratulates Dr Deepak Chamlagain, Life Member (LM-465) of the Nepal Geological Society, for receiving the **Nepal Vidya Bhusan-Ka** medal from the first President of Nepal, Dr. Ram Baran Yadav, for his Ph D Degree. The Society also congratulates him for receiveing the **Youth Science and Technology Award-2008** from Nepal Academy of Science and Technology (NAST).



Dr Deepak Chamlagain

The Nepal Geological Society expresses its hearty congratulations to Dr Suresh Das Shrestha, Mr Surendra Raj Pant, Mr Rajendra Pradhan, Mr Madan Ratna Manadhar, Dr Santa Man Rai, Dr Tara Nidhi Bhattarai, Dr Lalu Prasad Paudel, Dr Naresh Kazi Tamrakar, Dr Dinesh Pathak, Dr Danda Pani Adhikari, Dr Prakash Das Ulak, Dr Khum Narayan Paudayal, and Mr Mukunda Raj Paudel on their promotion to the post of **Associate Professor** at Tribhuvan University.



Dr Santa Man Rai



Dr Tara Nidhi Bhattarai



Mr Madan Ratna Manadhar



Dr Danda Pani Adhikari



Dr Prakash Das Ulak



Mr Mukunda Raj Paudel

The Nepal Geological Society expresses its sincere congratulations to Dr Prakash Chandra Adhikary, Dr Vishnu Dangol, Dr Megh Raj Dhital, and Dr Ram Bahadur Sah on their promotion to the post of **Professor** at Tribhuvan University.



Professor Dr Vishnu Dangol

The Nepal Geological Society expresses its hearty congratulations to Dr Subodh Dhakal for otaining a **Ph D degree** from the Department of Civil and Environmental Engineering, Saitama University, Japan. The topic of his dissertation was Evolution of Multiple Collisions and Micro-structures in Moderately Dense to Dense Granular Shear Flow.



Dr Subodh Dhakal



Dr Ranjan Kumar Dahal

The Nepal Geological Society expresses its hearty congratulations to Dr Ranjan Kumar Dahal for otaining a **Ph D degree** from the Faculty of Engineering, Kagawa University, Takamatsu, Japan. The topic of his dissertation was Evaluation of rainfall-induced landslides from the perspectives of stability analysis, rainfall threshold and hazard in the Nepal Himalaya and Shikoku, Japan.

INFORMATION ON SOME RECENT PUBLISHED BOOKS ON GEOSCIENCE

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Worlds before Adam: the Reconstruction of Geohistory in the Age of Reform by Martin J.S. Rudwick, Publication Info. Chicago : University of Chicago Press, 2008, ISBN: 9780226731285 (cloth : alk. paper), 0226731286 (cloth : alk. Paper

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1) **Journal of Nepal Geological Society (Proceedings of International Workshop on Seismology, Seismotectonics, and Seismic Hazard in Nepal Himalaya, 28–29 November 2006 and Fifth Nepal Geological Congress on Geology, Environment, and Natural Hazards Mitigation: Key to National Development, 26–27 November 2007), Vol. 38 (Special Issue), December 2008**

2) **Journal of Nepal Geological Society, Vol. 37, June 2008**

OBITUARY

Late Dr Johann Stöcklin
1921-2008



Nationality: Swiss, Residence of Switzerland
Birth: 1921, Switzerland; **Death:** 15 April 2008, Switzerland
Qualification: Ph. D. Federal Insttute of Technology, Zurich
Languages: German, French, English with some knowledge of Russian, Itallian, and Spanish

Professional Experience:

1979–2008	Petroconsultants, Geneva. Petroleum Geology Consultant. Participant in Studies of petroleum potential of basins in Madagascar, Guinea and Yeman.
1977–1979	Atomic Energy Organization of Iran (UNO Mission), Head of the Geological regional Department.
1975–1977	UNDP Nepal, Photogeologist for the mineral exploration project
1962–1975	Geological Survey of Iran, Chief Geologist and Head of Department (UNDP Project). In charge of all field and laboratory activity. Also co-ordinator of bilateral Swiss/ Iran Project for creation of a mapping department.
1950 – 1961	Iran Oil Co., And National Iranian Oil Co, field Geologist.
1949–1950	Geological Consultant

Career Hilights

Intimate familiarity with the geology of Nepal, including the publication in 1980 of the article "Geology of Nepal and its Regional Frame" in the Journal of Geological Society of London. Also produced several detail geological maps of parts of Nepal. Extensive knowledge of the geology of Iran which has some similarities with that of Nepal.

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ANNOUNCEMENT

All the Members of Nepal Geological Society,
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We are pleased to inform you that Nepal Geological Society (NGS) is going to organise the **Sixth Nepal Geological Congress (NGC-VI)** on the second week of November 2010 in Kathmandu, Nepal.

The Theme of the Congress is: "Geology, Natural Resources, Energy, and Infrastructures with Emphasis on Environment and Natural Disaster". We would like to take this opportunity to request you all to participate in this Congress and present your research papers and findings. We assure you that all papers presented in the Congress will be published after critical review in the Special Volume of the Journal of Nepal Geologic Society, which is widely circulated in almost all the continents. Please do not miss this opportunity to take part in the Congress, present your papers, meet with fellow scientists, exchange knowledge, and share experiences. We are sure that you will adjust your schedule accordingly to participate in the Congress.

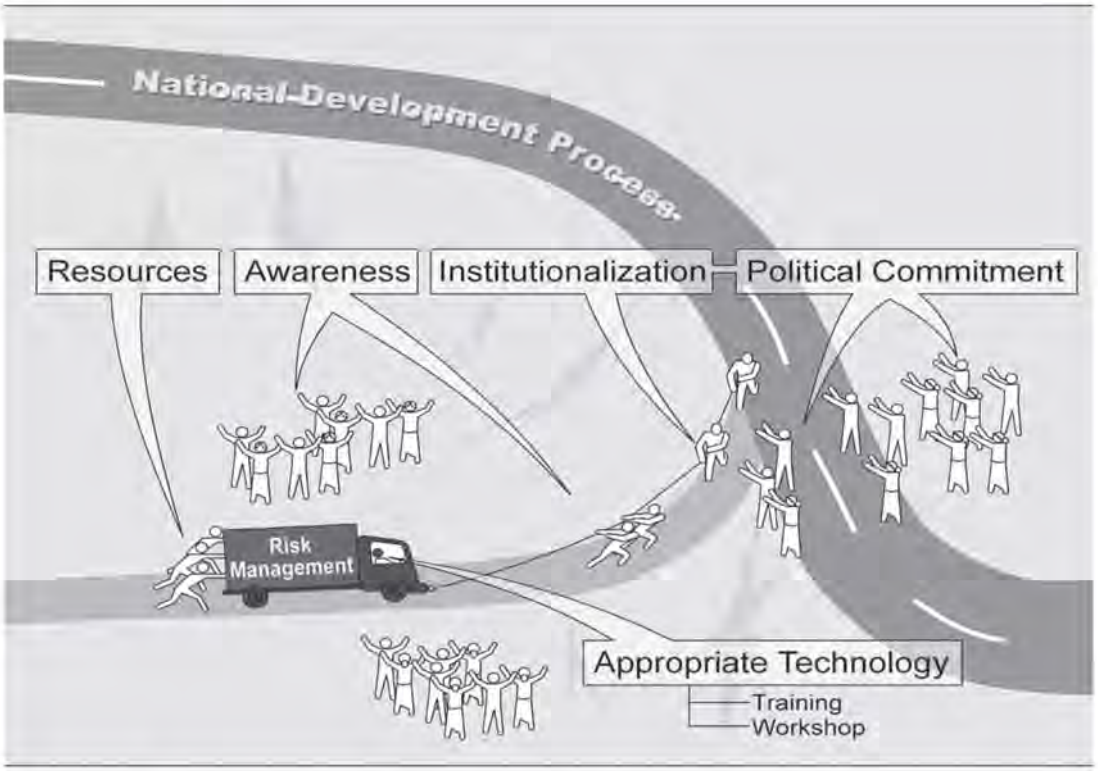
Details about the Congress will be given in the First Circular of the Congress soon. We also request you to visit our website *http://www.ngs.org.np/ngcvi.htm* for more information. Your response and comments in this regard are welcome.

Thank you.

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Reducing Earthquake Risk means:

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5. **Improving the seismic performance of existing buildings.**
6. **Improving the seismic performance of utility and transportation systems.**
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8. **Preparing for long-term community recovery following damaging earthquakes.**

NSET aims to assist all communities in Nepal to become safer against earthquake by 2020 AD by developing and implementing organized approaches to managing earthquake risk.

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National Society for Earthquake Technology – Nepal (NSET)

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